



# WORKSHOP MANUAL

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VW Passenger Cars

CLASSIC **CAR** ARCHIVE





# WORKSHOP MANUAL

VOLKSWAGEN, TYPES 11, 14 AND 15

VOLKSWAGENWERK GMBH · WOLFSBURG

EDITION 1952/57

CLASSICACTIVE

## FOREWORD

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erfect knowledge of the vehicle and the procedures relative to its maintenance, overhaul and repair, are the first requirements of a skilful and quick performance of any job to be done. Such knowledge provides the basis on which the confidence of the customers can be gained, while it is also the key to the economy of the VW Agency. Being aware of these facts, the manufacturer has compiled the information contained in this manual with a view to providing a valuable means for training servicemen and mechanics of the VW Service Organisation.

The introduction of the refined Volkswagen necessitated a revision of the Workshop Manual on account of quite a number of significant improvements and innovations. In the present edition of the manual, every attempt has been made to include the latest servicing procedures in order to give VW mechanics a real practical help.

The present Workshop Manual 1952/55 covers those Volkswagens produced after October 1952. When servicing cars manufactured earlier, reference should be made to the Workshop Manual 1951/52.

**VOLKSWAGENWERK G M B H**

SERVICE DEPARTMENT

CLASSICAR CHIVE

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# Description of Engine

# M

## General Description

The air-cooled Volkswagen engine is of the 4-cylinder, 4-cycle, O. H. V.-type with two pairs of cylinders horizontally opposed. It is mounted on the recessed flange of the rubber-cushioned transmission case by means of four bolts.

## Crankcase

The bipartite crankcase is cast of light-metal alloy. The crankcase halves are machined in pairs to very close limits and in consequence replacements must be made in pairs.

## Crankshaft

The crankshaft rests in four precision-insert special light-metal alloy bearings and is heat-treated at its points of support. Main bearing No. 2 is of the split type. The end thrust is taken by main bearing No. 1. The flywheel with starter gear ring is held by a gland nut and additionally secured to the crankshaft by four dowel pins. Timing gear and distributor drive gear are secured in place by a Woodruff key. The fan pulley is bolted to the crankshaft. A noil seal is fitted to the clutch side of the crankshaft and an oil thrower to the pulley side.

## Connecting Rods

The crank ends of the four connecting rods contain precision insert bearings of lead-bronze. The piston ends are provided with bronze piston pin bushings.

## Pistons

The pistons are of light-metal alloy and have three rings, of which the bottom one is the oil scraper ring. The piston pins are fully floating and held in place by means of circlips.

## Cylinders

The four cylinders of special cylinder casting are interchangeable and can be replaced separately together with the corresponding piston. The cylinders are provided with fins through which the air passes to effect a cooling.

## Cylinder Head

Each pair of cylinders has one mutual detachable cylinder head of light alloy casting. The cylinder head is also provided with cooling fins and it incorporates pressed-in valve seat inserts, valve guides, and threaded steel inserts for the spark plugs. The valves are of the overhead type. No gasket is used between the jointing faces of cylinder and cylinder head. Copper-asbestos gaskets, placed between the flanges of cylinder and cylinder head, prevent an egress of combustion gas.

## Valve Actuating Mechanism

The camshaft is carried in three bearings machined in the crankcase. It is driven from the crankshaft by helical gears. The camshaft timing gear is of light metal or of fiber. The valves are operated by the cams via push rods and rocker arms. Each cam operates in turn one of the valves of two opposed cylinders. The exhaust valves are plated with high quality chrome-nickel steel.

## Cooling System

The air cooling is done by means of a fan, which is attached to the extended generator shaft. It is driven from the crankshaft by an adjustable V-belt at double the engine revolutions. The fan sucks in air through an opening in the fan housing, and the air cools the engine by being forced through the fins of the cylinders and cylinder heads. The air flow is directed by air deflector plates; some of them are situated in the fan housing, and the others cover the cylinders. The throttle ring at the air intake opening of the fan housing is controlled by a thermostat, insuring a quick attaining and steady maintaining of the operating temperature.



## Oil Circulation

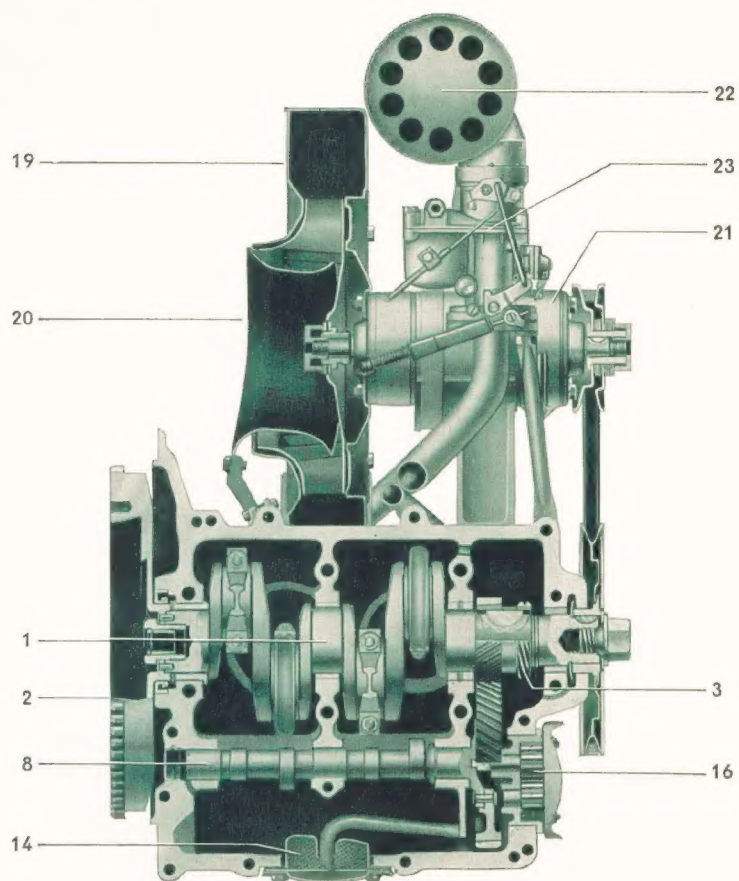
The pressure feed lubrication system includes a special oil cooler. The gear-type oil pump is situated at the gear side of the camshaft, from which it receives its drive. Oil is drawn from the lowest point of the crankcase and forced into the oil passages via the oil cooler. Part of the oil is fed via the crankshaft main bearings through the drilled passages in the crankshaft to the connecting rod bearings. Another part lubricates the camshaft bearings, and a third one is fed through the hollow push rods to the rocker arms, lubricating their bearings and the valve stems. Cylinder walls, pistons and piston pins are lubricated by splash. The returns to the crankcase bottom, where it is filtered by a gauze strainer at the lowest point before again entering the circulation.

## Oil Cooling

The oil cooler on the crankcase is positioned in the ducted air flow. The situation of the oil cooler is such that the oil forced up by the pump must pass through it before reaching the lubrication points. The drop in temperature in the oil cooler amounts to  $20^{\circ}\text{C} = 68^{\circ}\text{F}$ . This enables the oil to maintain its lubricating qualities even at high outside temperatures and at sustained high speed of the engine. In cold weather, when the oil is of higher viscosity, an oil pressure relief valve makes it possible for the engine to be lubricated directly, that is, by avoiding the oil cooling system.

## Oil Pressure Control

An automatic oil pressure switch for the oil pressure warning lamp is fitted to the oil pipe between pump and cooler. This switch opens an electric contact at a pressure of  $0.3\text{--}0.6\text{ atm.}$  ( $4.3\text{--}8.5\text{ lbs./sq. in.}$ ) interrupting the supply of electric current to the warning lamp. The lamp lights up when switching on the ignition and when the oil pressure is insufficient.



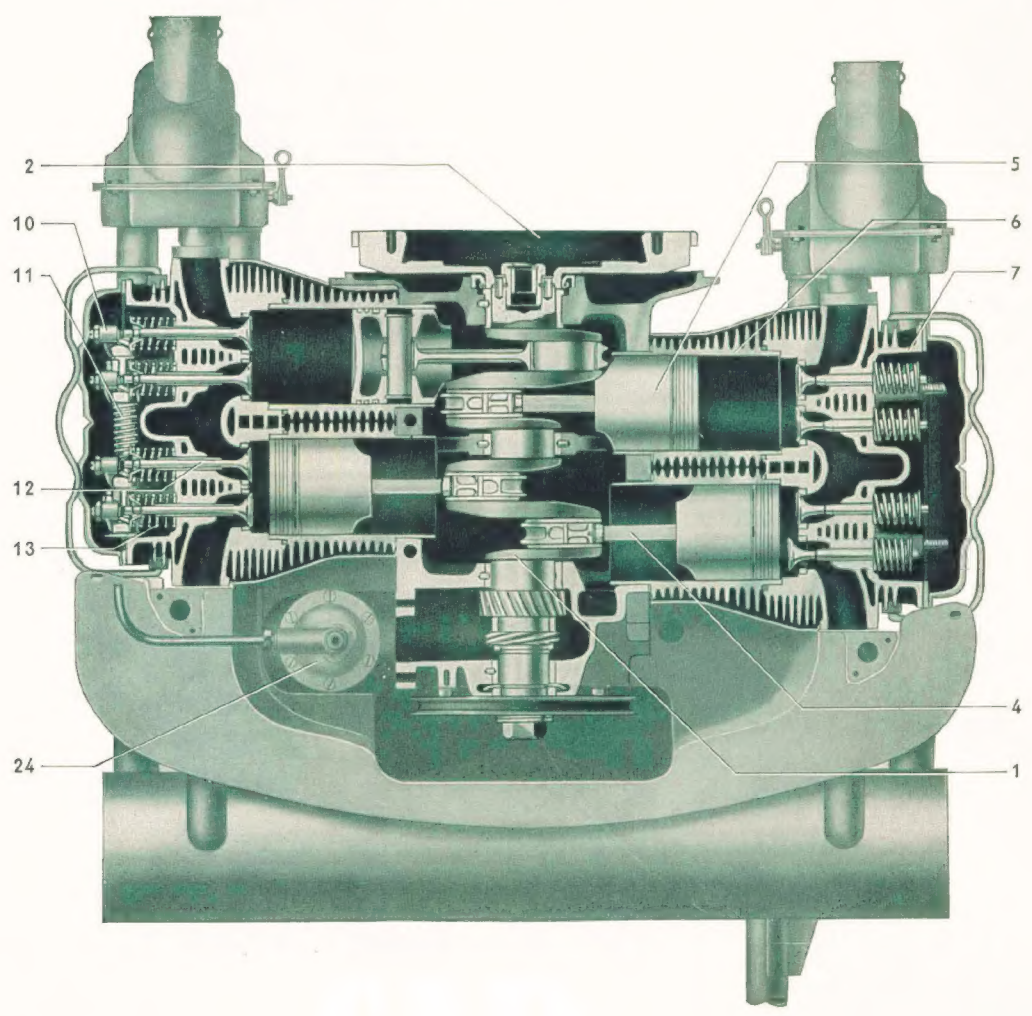
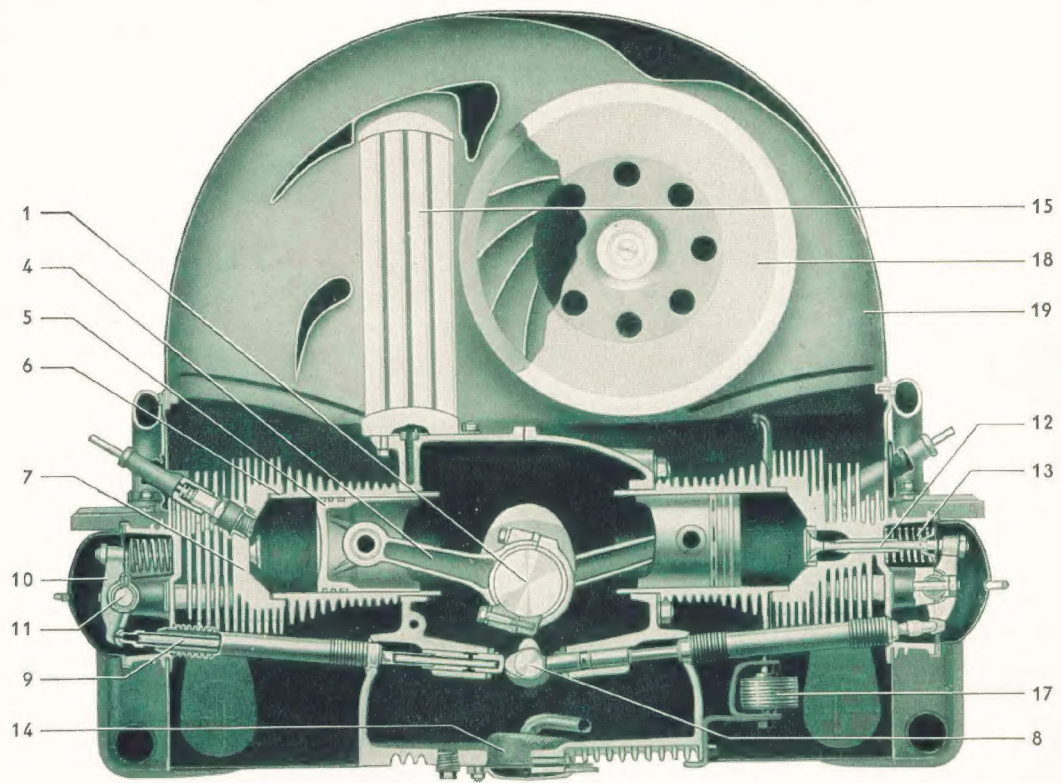
## The Volkswagen Engine

1131 cc. — 25 B. H. P.

### Sectional View

- |                            |                    |
|----------------------------|--------------------|
| 1 - Crankshaft             | 13 - Valve spring  |
| 2 - Flywheel               | 14 - Oil strainer  |
| 3 - Distributor drive gear | 15 - Oil cooler    |
| 4 - Connecting rod         | 16 - Oil pump      |
| 5 - Piston                 | 17 - Thermostat    |
| 6 - Cylinder               | 18 - Fan           |
| 7 - Cylinder head          | 19 - Fan housing   |
| 8 - Camshaft               | 20 - Throttle ring |
| 9 - Push rod               | 21 - Generator     |
| 10 - Rocker arm            | 22 - Air cleaner   |
| 11 - Rocker arm shaft      | 23 - Carburetor    |
| 12 - Valve                 | 24 - Fuel pump     |

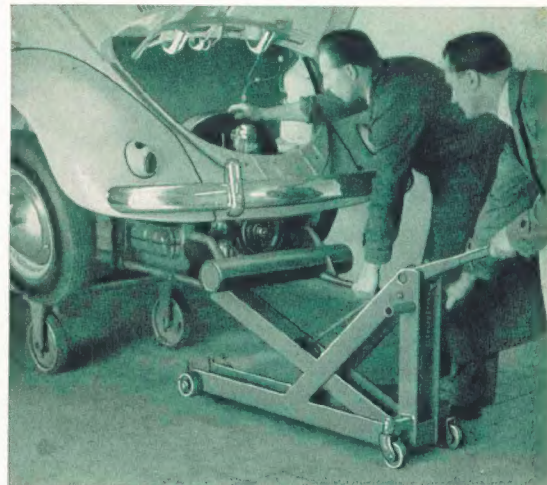
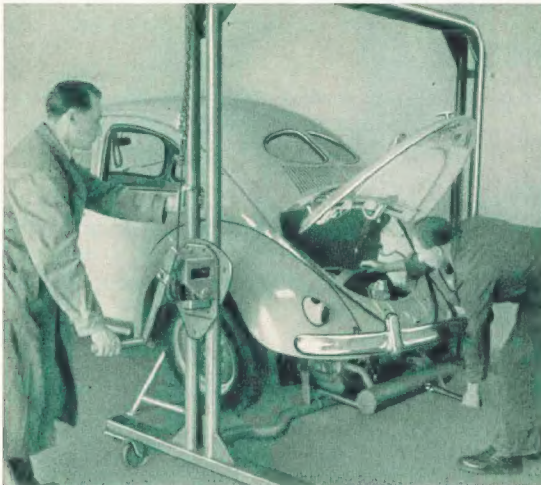






Following is a list of the facilities which, depending on the equipment of the workshop, are available to remove the engine:

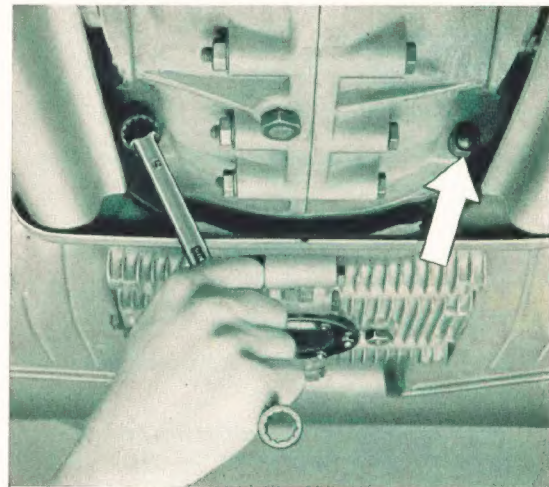
To lift car	To keep car in raised position	To remove engine
Gantry VW 301	Trestle VW 372 a	Gantry cross tube
Gantry VW 301	Trestle VW 372 a	Trolley jack
Free-wheel lift	—	Engine trolley VW 304
Free-wheel lift	—	Trolley jack
Roll-on lift	—	Engine trolley VW 304
Roll-on lift	Trolley stand VW 355/4	Trolley jack
Ramp VW 351/1	Trolley stand VW 355/4	Trolley jack



When jacking up, care should be taken that the rear end of the vehicle clears the ground about one yard prior to removing the engine.

## Engine Removal

- 1 - Turn fuel tap to "off" position.
- 2 - Disconnect ground strap (copper braid) from battery.
- 3 - Open rear hood.
- 4 - Remove air cleaner and engine rear cover plate.
- 5 - Disconnect: cables from terminals 51 and 61 on generator, cable from terminal 15 on ignition coil, and cable from oil pressure warning light contact.
- 6 - Disconnect choke control cable and accelerator cable from carburetor.
- 7 - Raise vehicle at rear or lift it on trolley stand or trestle.
- 8 - Disconnect both heating control cables and loosen flexible heater pipes from engine.
- 9 - Disconnect fuel hose from engine.



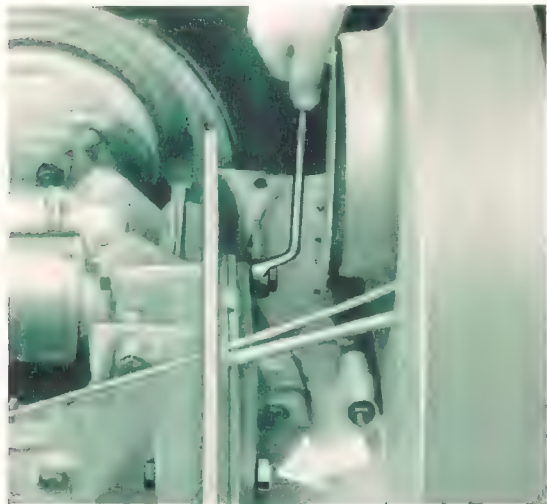


10 - Unscrew two nuts of the lower engine mounting bolts.

11 - Withdraw choke control cable and accelerator cable.

12 - Place engine trolley, or gantry cross tube, or trolley jack under engine.

13 - Have a helper to hold the upper two engine mounting bolts and remove nuts.



14 - Engine trolley:

Lower car until engine rests on trolley.

Trolley jack:

Raise jack until platform contacts engine.

15 - Withdraw engine until clutch release plate clears main drive shaft.

16 - Engine trolley: Lift up car, —

Trolley jack: Lower jack, —

and tilt the engine down at its rear end until it can be withdrawn.

When carrying out this operation, be sure not to distort or damage clutch release plate or main drive shaft.

## Engine Installation

This is a reversal of the preceding operations, but attention should be paid to the following points:

1 - Install engine only with engine rear cover plate removed.

2 - Check central position of clutch plate, using special tool VW 219.

3 - Check main drive shaft for run-out. The main drive shaft is to be straightened if eccentricity exceeds 0.20 mm (0.0079").

4 - Check clutch release bearing and clutch release plate for wear and cracks, renew if necessary.

5 - Examine pilot bush in flywheel gland nut for wear and fill it with 10 g (0.35 oz.). Special Grease VW — A 052.

6 - Lubricate main drive shaft splines and pilot, starter shaft bush, starter drive pinion, and flywheel gear ring with Special Grease VW — A 051.

7 - Thoroughly clean transmission case and engine flange.

8 - When replacing engine, care must be taken to prevent damage to gland nut bush and clutch release bearing and to avoid bending of main drive shaft.

To facilitate entry of main drive shaft into clutch plate and gland nut bush, rotate engine at V-belt (engage a gear to steady main drive shaft). Avoid jamming the choke control cable sleeve.

9 - When mounting engine, first insert the lower engine mounting bolts into their corresponding holes in transmission case flange. Press engine firmly against flange, paying attention to proper seating all around the flange. First slightly tighten the upper mounting bolt nuts and then the lower ones. After that, screw nuts fully tight in same order.

10 - Adjust choke control and accelerator cables.

It is recommended to adopt the following sequence of operations in disassembling and assembling the engine:

## Disassembly

- 1 - Drain engine oil.
- 2 - Remove engine front cover plate.
- 3 - Remove fuel lines.
- 4 - Remove carburetor.
- 5 - Disconnect cable between distributor and ignition coil.
- 6 - Remove fan housing and generator as a unit.
- 7 - Remove intake manifold and ignition cable protection tube.
- 8 - Remove muffler and heater assy.
- 9 - Remove fuel pump cover plate.
- 10 - Remove heating channels and both cylinder cover plates.
- 11 - Remove clutch.
- 12 - Remove crankshaft pulley.
- 13 - Remove crankshaft pulley cover.
- 14 - Remove oil pump.
- 15 - Remove fuel pump.
- 16 - Remove ignition distributor.
- 17 - Remove distributor drive pinion.
- 18 - Remove cylinder head covers.
- 19 - Remove rocker arm shaft.
- 20 - Remove cylinder heads.
- 21 - Remove valve push rod tubes and valve push rods.
- 22 - Remove deflector plates below the cylinders.
- 23 - Remove cylinders.
- 24 - Remove pistons.
- 25 - Remove oil cooler.
- 26 - Remove flywheel.
- 27 - Remove oil strainer.
- 28 - Disassemble crankcase.
- 29 - Remove camshaft and crankshaft.

## Assembly

Assembling the engine is a reversal of the above operations. Reference should be made, however, to the following pages containing detailed information and special hints as to the correct removal and installation of the individual parts.

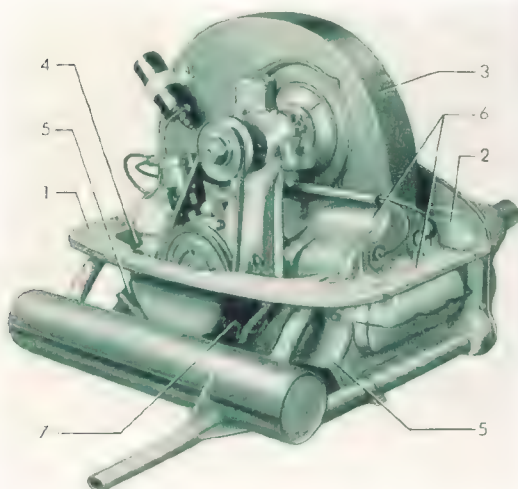


## Removing and Installing Cover Plates

### Removal

Sequence of operations:

- 1 - Take off engine rear cover plate prior to removing engine.
- 2 - Remove engine front cover plate.
- 3 - Remove fan housing and generator as a unit.
- 4 - Remove fuel pump cover plate.
- 5 - Remove heating channels after having removed the exhaust system.
- 6 - Remove both cylinder cover plates.
- 7 - Remove crankshaft pulley cover after having removed the pulley.
- 8 - Remove deflector plates after having taken off valve push rod tubes.



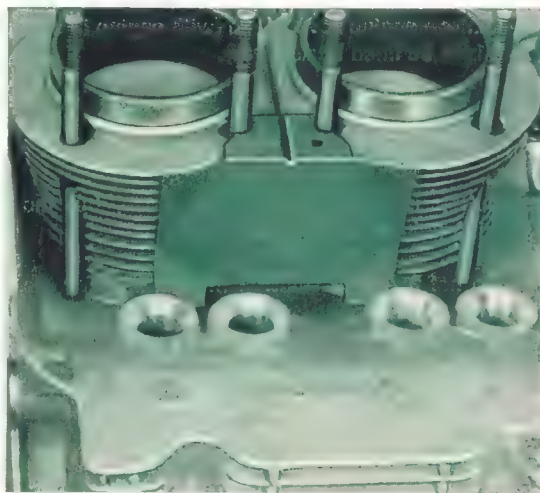
- |                              |                          |
|------------------------------|--------------------------|
| 1 - Engine rear cover plate  | 4 - Cover plate          |
| 2 - Engine front cover plate | 5 - Heating channel      |
| 3 - Fan housing              | 6 - Cylinder cover plate |
|                              | 7 - Cover plate          |

### Installation

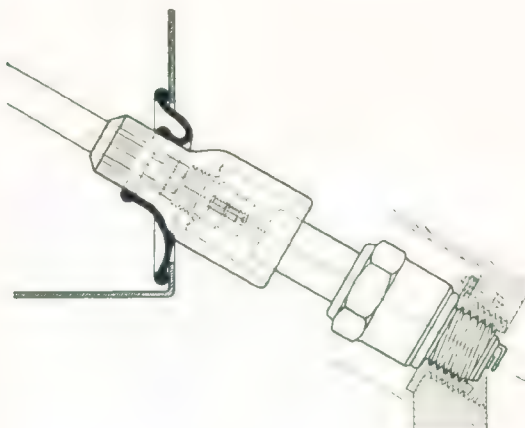
Installation is a reversal of the above, but the following points require attention:

- 1 - The deflector plates below the cylinders must be installed prior to the push rods and push rod tubes. Be sure of their proper position. If

the necessity should arise, bend the plates until they tightly bear on the cylinder head studs to avoid a rattling noise and a working loose during operation.



- 2 - When replacing cylinder cover plates, attention should be paid to condition and sealing of spark plug rubber caps.



- 3 - The cylinder cover plates should fit snugly on the exterior of the fan housing to prevent loss of cooling air.
- 4 - Prior to installing the engine front cover plate, check condition of weatherstrip.

## Removing and Installing Engine Rear Cover Plate

(Engine in situ)

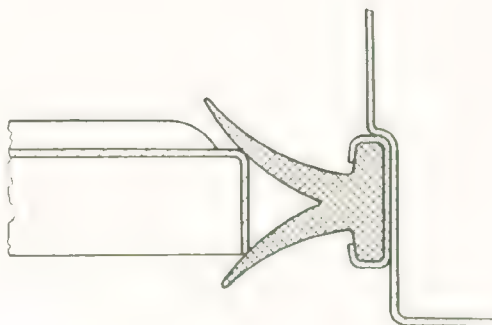
### Removal

- 1 - Remove oil filler and oil level dipstick.
- 2 - Release slotted screws of engine cover plate.
- 3 - Remove engine cover plate (with engine in situ, it is to be lifted backwards).

### Installation

Installation is a reversal of the above, but the following points should be observed:

- 1 - Do not forget to reinstall the washers for the slotted screws.
- 2 - After engine has been installed, the weather-strip lips should be positioned as shown in the illustration.



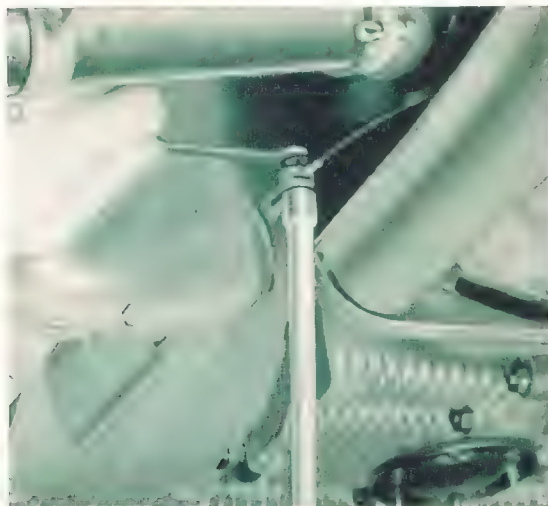
Damaged weatherstrips are to be renewed.

## Removing and Installing Heating Channel

(Engine in situ)

### Removal

- 1 - Remove engine rear cover plate.
- 2 - Remove muffler.
- 3 - Detach heating control cable.



- 4 - Remove heating junction box and exhaust pipe.
- 5 - Release slotted screws of heating channel.
- 6 - Remove heating channel.

### Installing

Installation is a reversal of the above, but the following points should be observed:

- 1 - Check heating channel for damage prior to installation.
- 2 - Both the heat control valve and the control sheet at the rear should freely move and must fully open and close simultaneously to insure a correct heating control.
- 3 - Adjust heating control cable so that the valve at the front of the heating channel is fully closed with the heating control knob pushed in.

## Removing and Installing Fan Housing

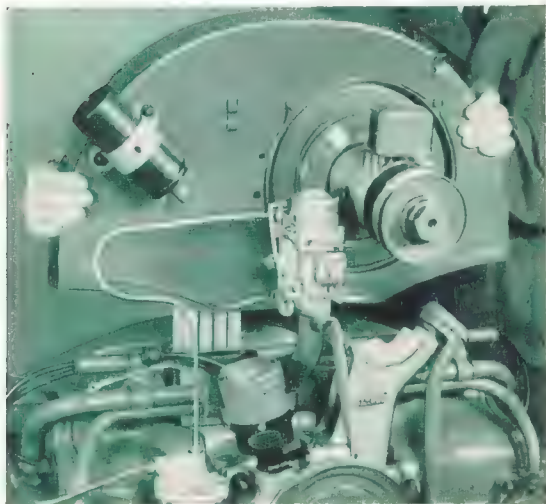
(Engine removed)

### Removal

- 1 - Remove fan belt.
- 2 - Remove generator strap and disconnect cable from ignition coil.
- 3 - Release slotted screws on both sides of fan housing.
- 4 - Detach spring of automatic cooling air control and release throttle ring screws.



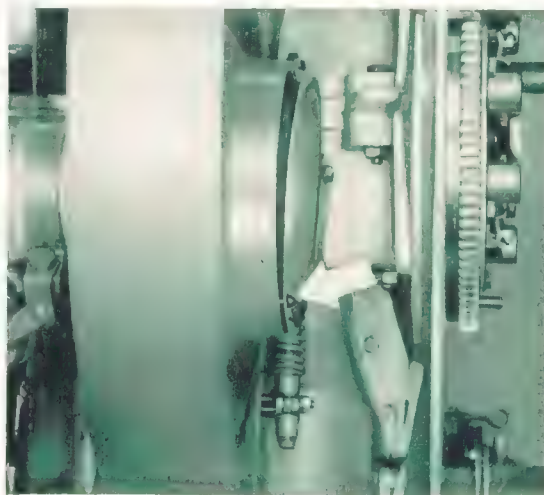
- 5 - Lift off fan housing and generator.



### Installation

Installing is a reversal of the preceding operation, but the following points should be noted:

- 1 - Examine fan housing for damage and loose air deflector plates.
- 2 - There must be no "blow-past" between fan housing and cover plates of cylinders. If necessary, bend plates into correct position.
- 3 - Insert throttle ring and screw it to the holding plate on the operating shaft, taking care that there is no offset between the intake flange and the throttle ring. The throttle ring is designed to occupy a tilted position — as seen from the side and from above —, and no attempt should



be made to bend the holding plate as such practice would result in a mal-functioning of the cooling system. The throttle ring is centered to the intake flange by moving it in its clearance holes.

- 4 - Connect return spring.
- 5 - Adjust throttle ring.



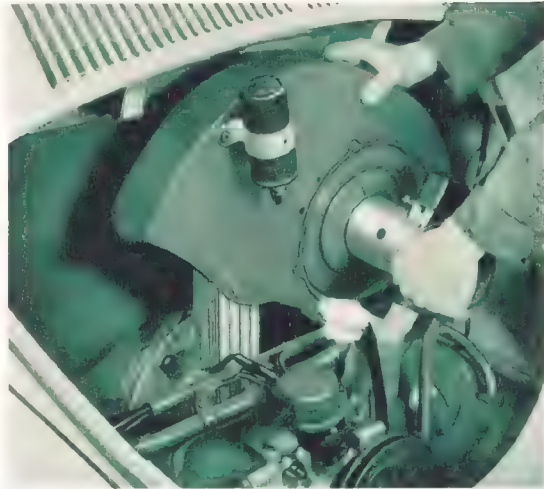
## Removing and Installing Fan Housing

(Engine in situ)

### Removal

- 1 - Disconnect battery.
- 2 - Remove rear hood together with hinge bracket.
- 3 - Disconnect cables from generator and ignition coil and cable from oil pressure switch.
- 4 - Detach and pull out accelerator and choke control cables and remove conduit tube.

The other operations for removing and installing fan housing are the same as with the engine removed.



## Thermostat-Controlled Intake of Cooling Air

### Inspection and Adjustment

Regular attention should be paid to the adjustment of the cooling air intake in connection with the routine service. A through inspection is especially important when cold or warm seasons begin.

When adjusting the air cooling unit, it should be borne in mind that a premature opening or a permanent "open" position of the throttle ring are responsible for the engine attaining its operating temperature too slowly. These conditions are most liable to produce incessant carburetor spitting (flat spot) and an increased fuel consumption. If the throttle ring opens too far, it may foul the fan resulting in a considerable noise. A retarded opening of the ring in the warm season creates an excessive heat development when the engine is made subject to sustained high load.

If the throttle ring remains "open" whilst the engine is cold, the thermostat may be defective. To prevent an overheating of the engine, the throttle ring fully opens automatically when the cooling system is out of order.

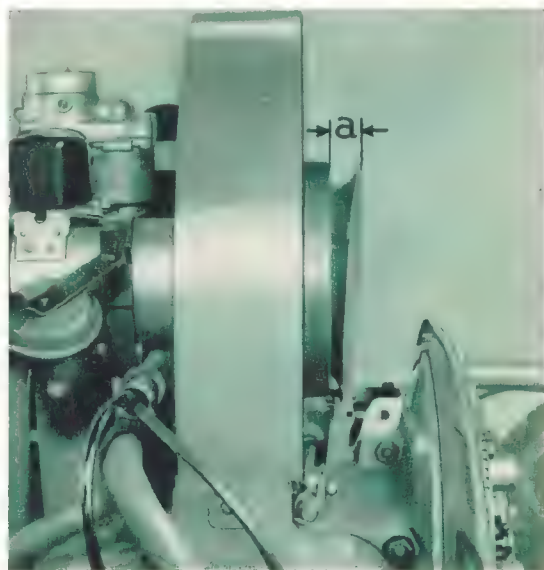
### Inspection

- 1 - When the engine is cold, the throttle ring should rest slightly pre-loaded against the air intake flange.
- 2 - The engine should be allowed to warm up until the upper end of the thermostat touches the stop of the support by the heat expansion (at normal outside temperature).

The distance from the middle of the intake flange to the edge of the throttle ring should measure 20 mm (0.79'') in this position.

### Adjustment when Assembling Engine

- 1 - Lift thermostat to the upper stop of its support.
- 2 - Adjust throttle ring so that it opens 20 mm ( $a = 20 \text{ mm}/0.79''$ ) as described above.



3 - Tighten operating lever.

4 - Tighten thermostat in position. Be sure the faces milled in the tapped boss of the thermostat fit properly in the guide hole of the support. For this purpose it may become necessary to rotate the thermostat backward by max. half a turn. When the thermostat has been tightened, the throttle ring rests slightly pre-loaded against the intake flange.

2 - Allow engine to warm up until upper end of thermostat touches upper stop of the support (at normal outside temperature).

3 - Adjust throttle ring so that it opens 20 mm (0.79").

4 - Tighten operating lever.

#### Adjustment with Engine in Car

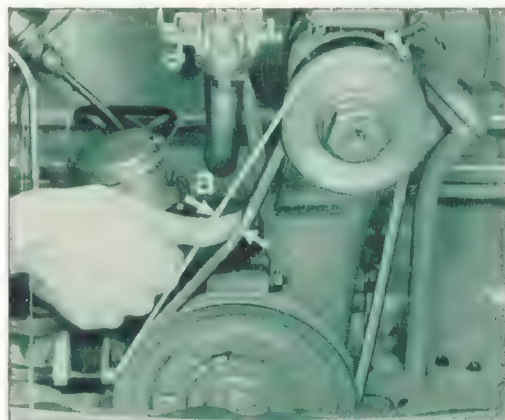
1 - Release throttle ring operating lever.

Make sure that throttle ring and linkage are freely moving in each position.

## Checking Fan Belt Tension

#### General Note

Generator and cooling system are driven by the fan belt. Due to the power absorbed by these two units, the fan belt is subjected to considerable stress, especially at high speed and when shifting down. To insure adequate cooling and long service life of the belt, it is of utmost importance to maintain the belt at correct tension. If the belt is too slack, a slippage occurs between pulley and belt, leading to an overheating of the engine. Excessive tension creates undue stress and is liable to cause breakage of the belt and damage to the generator bearings.



$a = 15 \text{ mm (about 0.6 in.)}$

It is important to prevent oil getting on to the fan belt when lubricating the engine. Oily fan belts can in many cases be made serviceable again by washing them in an alkaline degreasing solution. Fuel must not be used.

Fan belts which have become impregnated with oil are generally unserviceable and must be renewed.

#### Examination

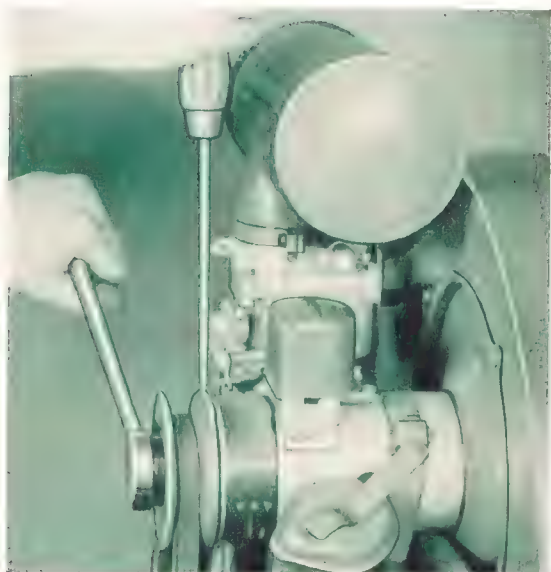
The belt, when firmly pressed with the thumb at midpoint, must yield approximately 15 mm (about 0.6").

No traces of excess use, such as frayed edges and cracks, should be perceptible.

#### Adjusting Fan Belt Tension

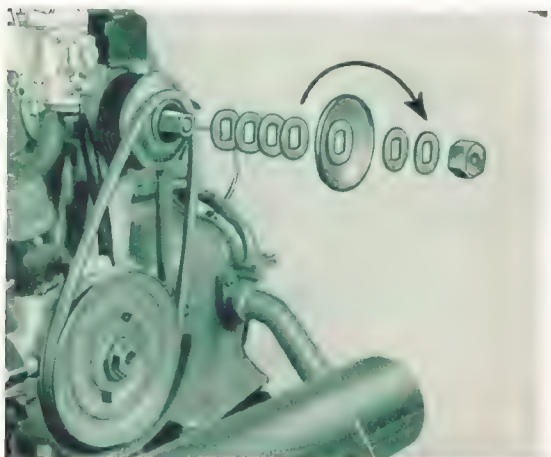
1 - Remove nut from generator shaft pulley. When loosening or tightening nut, insert a screwdriver in the slot cut into the inner half of the pulley, and support it against upper generator housing bolt.





2 - Remove outer pulley half.

3 - Arrange spacer washers as required to correct the fan belt tension.

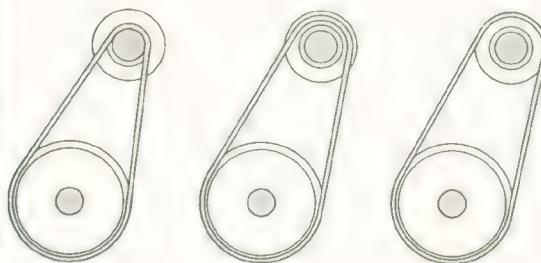


The tension of the fan belt is adjusted by fitting more or less spacer washers between the two pulley halves until the belt yields 15 mm (.6'') by a firm thumb pressure. Belt slackness is taken up by removing one or more washers, and if the belt is in too much tension, one or more washers should be added.

**Note:**

From Chassis No. 1—0575415 onwards, the fan belt allows a finer adjustment, as, beside the six spacer washers of 1.5 mm (.06'') thickness in front of the outer pulley half, there are further 8 washers of 0.5 mm (.02'') thickness between the two pulley halves.

When the belt has stretched itself, or is worn, to an extent where no washers remain between the pulleys to obtain the correct tension, the belt is to be renewed, as the amount of cooling air becomes then inadequate due to the reduced number of revolutions of the fan. It is also important that the belt does not bear on the base circle of the pulley, that is, on the washers.



Wrong

Correct

Wrong

4 - Install outer pulley half.

**Note:**

From Chassis No. 1—0753096 fan, generator and small fan pulley are balanced dynamically as a unit at 1000 r. p. m. The then remaining permissible unbalance amounts to max. 3 cmg. A balance weight is spot-welded to the inside of the flange around the circumference of the outer pulley half and to the fan as required. The flange of the outer pulley half is already made wider from Chassis No. 1—0722916, from 10.5 mm to 20 mm (.41'' to .8''). After the unit is balanced, both pulley halves are provided with a paint mark. These paint marks must be aligned when assembling. To maintain the true running of the dynamically balanced generator/blower unit with safety, the front half of the generator pulley is welded to the pulley hub from Chassis No. 1—0929746. The rear pulley half is held in place by lugs of different widths, allowing a reinstallation in its original position only. The pulley is secured to the generator armature shaft by means of a hex. nut (21 mm) (.82'').

5 - Place all surplus washers between outer pulley half and pulley nut so that all the spacer washers are retained on the pulley hub.

6 - Tighten pulley nut.

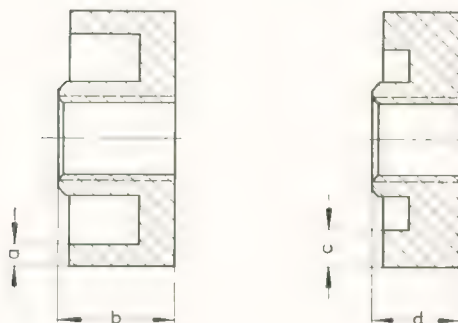
Loose pulleys of previous design cause considerable wear and damage to their hubs. The belt is thus subjected to excessive wear and tear due to the consequent wobbling of the pulley.

Worn pulleys must be renewed.

**Note:**

From Chassis No. 1408865 the overall thickness of the fan nut has been decreased by 4 mm.

This modification is to prevent the nut from working loose under all operating conditions. The nut can be installed on all earlier engines.

**Before**

a - Width of nut face (3.12 mm)  
b - 16.25 mm

**New**

c - Width of nut face (5.12 mm)  
d - 12.25 mm

**Note:**

Newly installed fan belts are apt to stretch to some extent and to yield slightly at their flanks, causing belt slackness no later than after the first 50—100 km (30—60 miles). It is, therefore, essential to check the fan belt in time and adjust it if necessary.

No attempt should be made to remove the fan belt by means of a screwdriver without backing off the pulley nut, as such practice will destroy the belt and damage the pulley.



## Removing and Installing Intake Manifold

### Removal

- 1 - Remove fan housing.
- 2 - Remove carburetor.
- 3 - Remove nuts and bolts of intake manifold.
- 4 - Lift off distributor cap and detach spark plug connectors.
- 5 - Take off intake manifold.

should be made to assure that it is not warped.

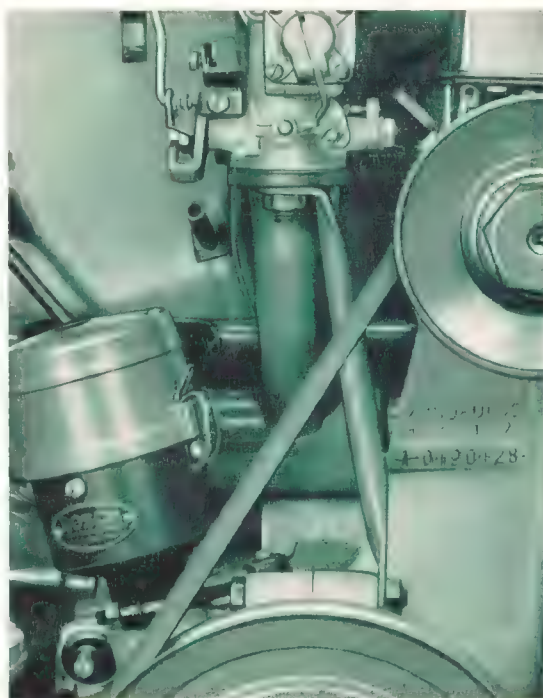
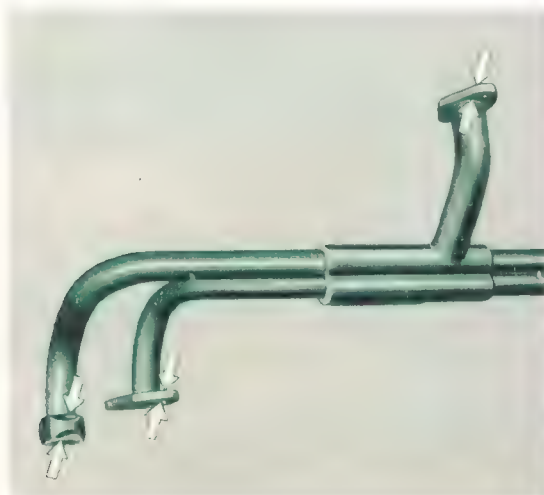
If necessary, straighten the manifold. If it has been heated, make sure that no scales remain in the interior.

### Installation

Installation is accomplished by reversing the removal procedure, but the following hints should be noted:

- 1 - Check manifold flanges for clean and smooth contact surfaces. The manifold should also be inspected for cracks.

- 4 - Do not forget to reinstall intake manifold



- 2 - Clean cylinder head filter element, replace if necessary.
- 3 - Use new gaskets.  
Before installation of the manifold, a check

support between carburetor flange and crankcase.

- 5 - Tighten nuts and bolts evenly and securely to prevent leaks.

## Removing and Installing Muffler (Silencer)

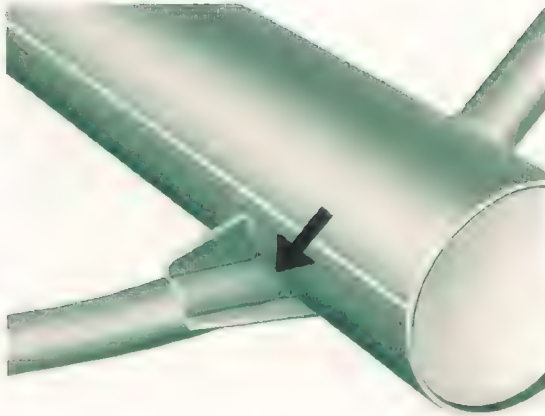
### Removal

- 1 - Remove bolts of pre-heating pipe flanges.
- 2 - Release exhaust pipe clamps.
- 3 - Remove bolts of rear exhaust pipe flanges.
- 4 - Take off muffler.

### Installation

Installation is accomplished by reversing the removal procedure, but the following points should be noted:

- 1 - Check muffler and exhaust pipes for cracks and damage. Bent or out-of-round exhaust pipes must be repaired.



The welded joint of the muffler and the tail pipe is particularly susceptible to damage by impacts. Leaks at this point are liable to cause the exhaust fumes entering the engine compartment and the interior of the car with the heating turned on.



2 - Use new gaskets.

3 - There should be a perfect seal at conjunction to front exhaust pipes.

4 - With the engine in situ, the tail pipe must not touch the lower edge of the body. If necessary, the pipe is to be heated prior to bending it.



#### Note:

The muffler meets in every respect the operating conditions of the engine and the requirements of a good muffling of the noise caused by the engine exhaust. Thorough experiments have shown that it is unimportant to the function of the engine whether the muffler is provided with one or two tail pipes, as long as these are attached to the middle chamber of the muffler. The tail pipes must, however, never be fitted to the two outer chambers nor should any other modification be carried out in order not to affect the muffling.

## Removing and Installing Heating Junction Box and Exhaust Pipe

### Removal

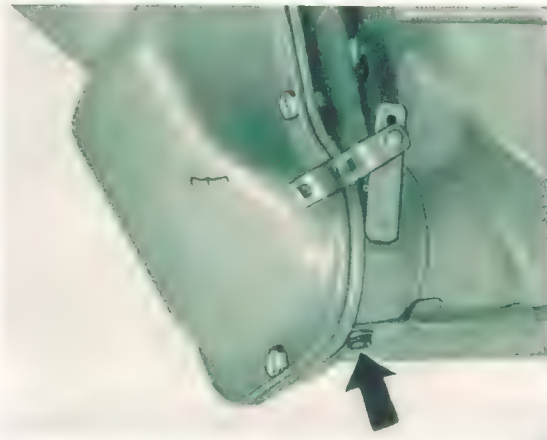
1 - Detach flexible heating pipe from junction box.

2 - Detach heating control cable.

3 - Remove nuts from exhaust flange.

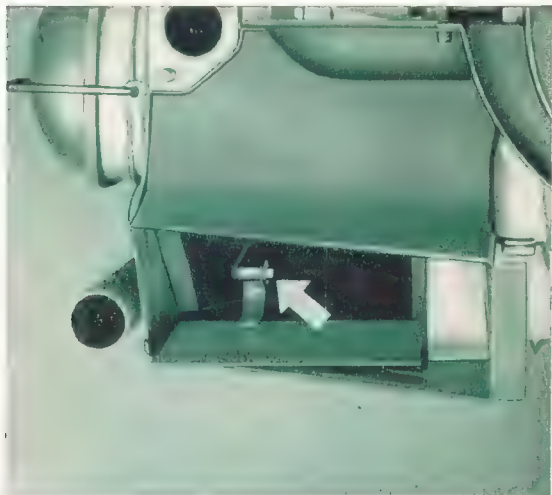
4 - Release exhaust pipe clamp.

5 - Remove slotted screw at the lower side of the junction box.





- 6 - Remove the cotter pin and unhook the connector rod from the heat control sheet.



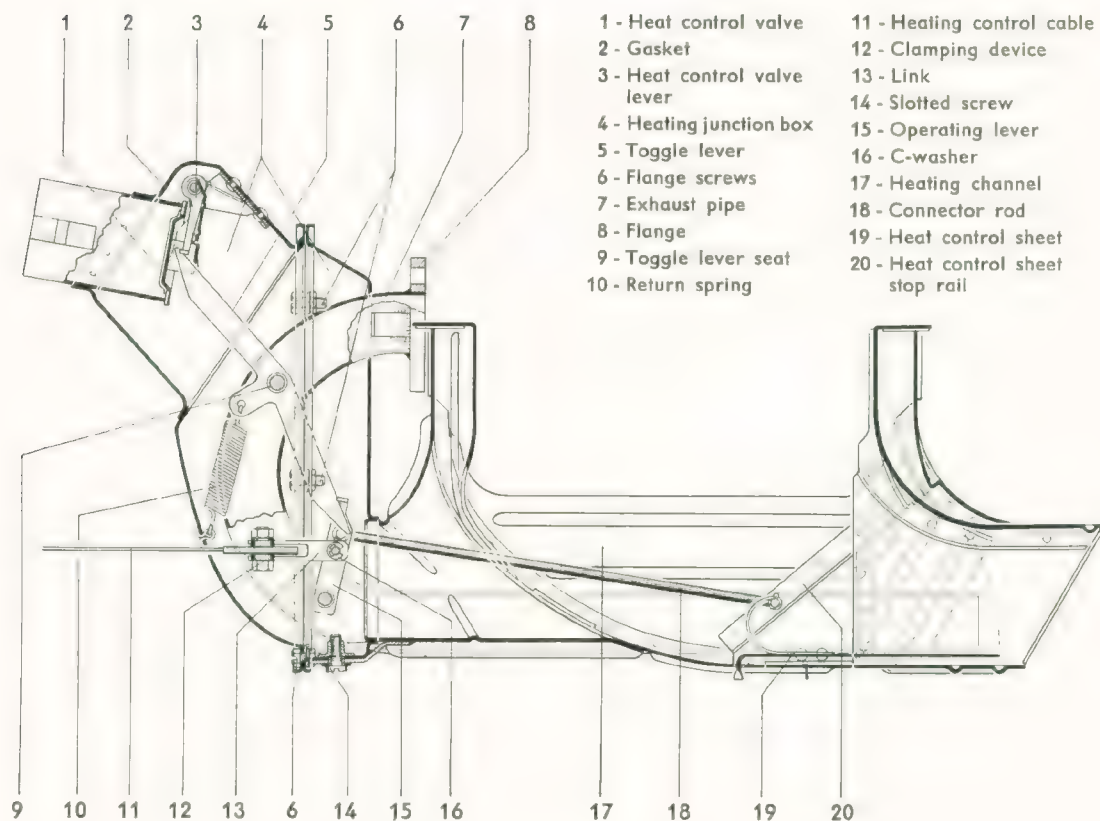
- 7 - Take off heating junction box and exhaust pipe.

#### Installation

This is carried out in reverse order to removal, but the following points should be heeded.

- 1 - Important! Check heating junction box and exhaust pipe for leaks and damage. Leaks at this points may lead to exhaust fumes entering the interior of the car through the warm air heating.
- 2 - The contact surfaces of the flanges must be clean and even. Distorted or bent flanges are to be repaired.
- 3 - Use new gaskets.
- 4 - All moving joints are to be lubricated with a mixture of graphite and high melting point grease.

## Heating Junction Box Assembly and Disassembly



### Disassembly

1 - Remove flange screws.



2 - Take off junction box half.

3 - Lift toggle lever from its seat.



4 - Unhook return spring from toggle lever and junction box.

5 - Remove cotter pin and withdraw heat control valve.



6 - Remove cotter pin at operating lever and unhook connector rod.

7 - Remove C-washer at link.

8 - Take off the link bolt.

9 - Take off the link.

### Assembly

Assembly is effected by reversing the preceding operations, but the following points should be observed:

1 - Clean all parts and inspect them for damage.

2 - The heat control valve must fully close off the heating junction box outlet to assure that no warm air enters the interior of the car with the control knob in the closed position. Inspect the gasket for wear and damage and replace complete valve if either condition is evident.

3 - The seats of the toggle lever and operating lever are to be lubricated with a mixture of graphite and high melting point grease. Only use as much high melting point grease as is necessary to bind the graphite.

4 - Operate the heat control valve and control sheet to check for proper function.



**Note:**

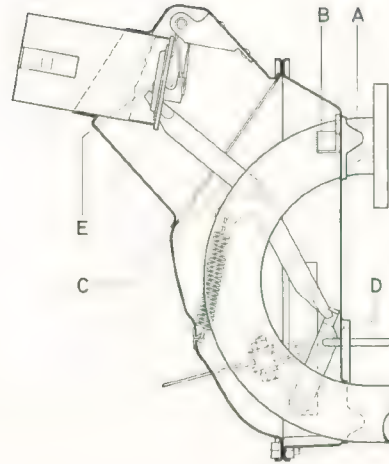
From Chassis No. 1429178 the connections between heating junction box and exhaust pipe and the control linkage in the junction box have been modified as detailed below:

**1 - Heating Junction Box**

The edges of the two holes in the junction box through which the exhaust pipe passes are flanged to take the form of a collar with two tabs (A) for spot-welding the junction box to the exhaust pipe. Apart from that, the bracket (B) is repositioned 20 degrees further towards the top. These modifications increase the strength of and provide a better seal between junction box and exhaust pipe.

**2 - Toggle Lever and Hot Air Control Valve**

The tips of the toggle lever (C) are reinforced and the edges rounded off. The contact surface of the now cranked operating lever (D) is wider to conform with the reinforced toggle lever. The contact surface for the toggle lever at the hot air control valve is curved and enlarged; a stop prevents the toggle lever from slipping off the curved surface (E).

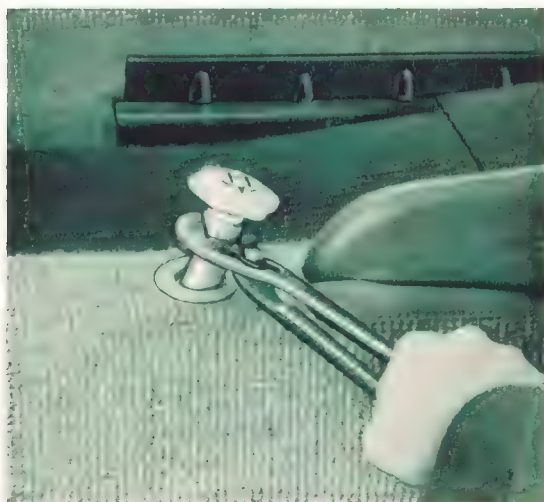


The object of these modifications is to reduce the frictional resistance of the control linkage.

## Removing and Installing Heating Control Cable

**Removal**

- 1 - Raise the car.
- 2 - Release nut of clamping device (use 9 and 10 mm open end wrenches to avoid breakage of cable consequent upon distortion of link).
- 3 - Disconnect control cable from clamping device.
- 4 - Remove rubber grommet from conduit tube and slide it off the cable.



- 5 - Release the threaded cap and pull out the knob and cable (note proper entry of cable ends into conduit tubes).

**Installation**

Installation is accomplished by reversing the removal procedure, but the following notes should be followed:

- 1 - Grease cable with Universal Grease VW A — 052.
- 2 - The longer end of the heating control cable must be inserted into the right-hand conduit tube (as seen in driving direction).
- 3 - Before installing the heating control knob unit, turn the knob anti-clockwise until stop can be and then turn it clockwise three turns.
- 4 - Insert heating control knob unit, taking care that the guide nose enters the slot in the



threaded sleeve. The heating control knob unit is properly installed if the threaded sleeve does not stick up above the edge of the conduit tube.

- 5 - Check rubber grommets for wear and replace as necessary.
- 6 - Check heating system for proper function.

## Heating Control Knob Unit Disassembly and Assembly



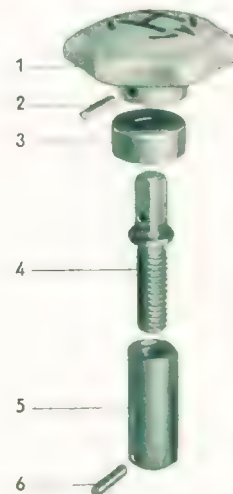
### Disassembly

- 1 - Release clamping device and withdraw the cable.
- 2 - Release threaded cap and pull out heating control knob unit until the cable can be seen.
- 3 - Remove the cable pin by means of a drift and take off heating control knob unit.
- 4 - Screw off the threaded sleeve.
- 5 - Drive out grooved pin and withdraw knob from the spindle.
- 6 - Lift off threaded cap.

### Assembly

Assembly is accomplished by reversing the above operations, but the following points should be observed.

- 1 - Clean all parts and lubricate them with Universal Grease VW A — 052.
- 2 - Carefully drive in the grooved pin in order not to damage the knob.



- 1 - Knob
- 2 - Grooved pin
- 3 - Threaded cap
- 4 - Spindle
- 5 - Threaded spindle
- 6 - Cable pin



## Muffler Removal and Installation

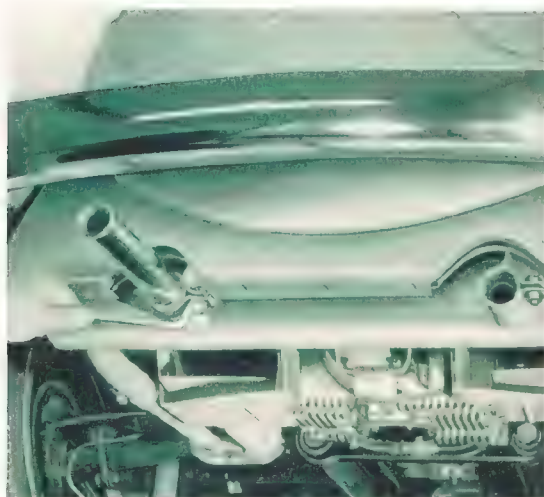
(With engine in situ)

### Removal

- 1 - Lift rear end of car and support it on trestles.
- 2 - Remove the five engine rear cover plate attaching screws and lift off cover plate rearward.

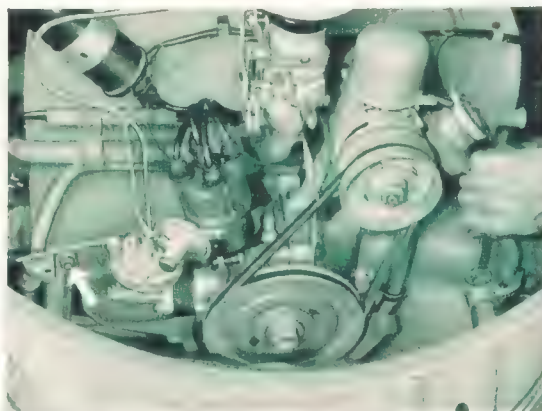


- 3 - Remove the four pre-heating pipe flange screws.
- 4 - Loosen tail pipe clamps and pull off the two tail pipes.



- 5 - Loosen the clamps at the front exhaust pipes.

- 6 - Remove the four nuts at the muffler flanges.

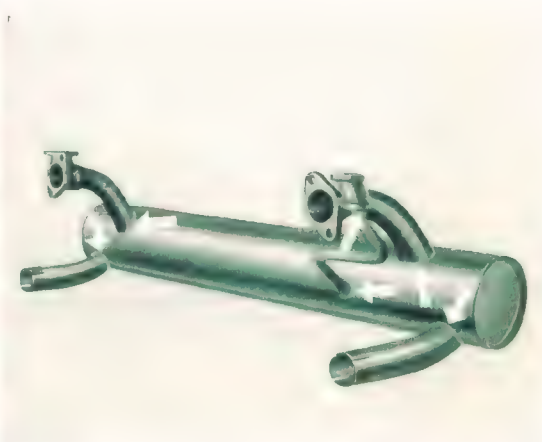


- 7 - Withdraw muffler and lower it for complete removal. Take off all flange gaskets.

### Installation

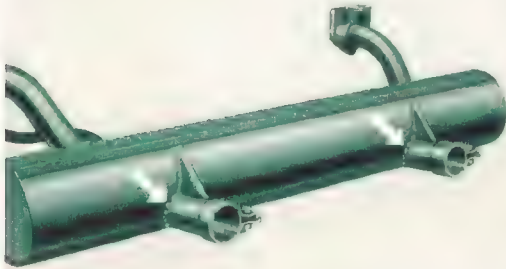
Installation is accomplished by reversing the removal procedure, but the following points should be noted:

- 1 - Check muffler and exhaust pipes for cracks and damage prior to installation.



The pipes welded to the muffler can be straightened, if necessary.

The welded joints at the muffler are particularly susceptible to damage by impacts. Leaks are liable to cause exhaust fumes



entering the engine compartment and the interior of the car when the heating is turned on.

Bent or out-of-round tail pipes should be replaced in all cases.

**Note:**

The muffler must only be used in conjunction with the corresponding intake manifold, as the pre-heating of the mixture would otherwise be impaired, leading to a loss in the engine output.

2 - Use new gaskets.

3 - There should be a perfect seal at connection to front exhaust pipes.

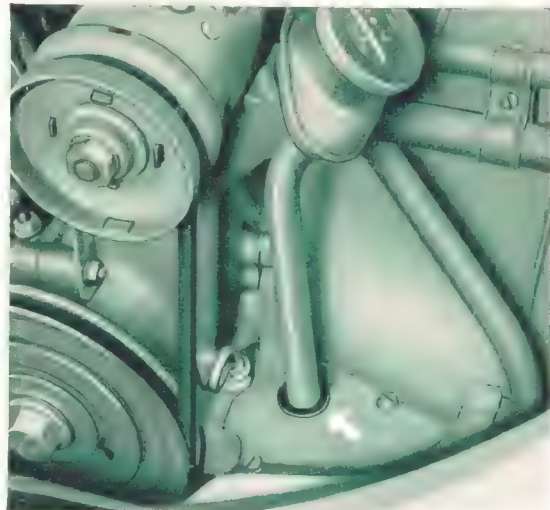
4 - The two tail pipes must not contact the lower edge of the body. If necessary, straighten the exhaust pipes in heated condition prior to installing the tail pipes.



5 - Push the tail pipes into the exhaust pipes until resistance can be felt and make sure there is a snug fit between tail pipes and exhaust pipes.

6 - After engine rear cover plate is installed, the upper lip of the weatherstrip should be positioned on top of the cover plate and the lower lip must bear on the edge of the plate flange. Damaged weatherstrips are to be replaced.

7 - The breather pipe grommet must squarely bear on the cover plate.



## Tail Pipes

Strong evidence of blisters on tail pipes — as well as discoloration — is usually caused by exhaust tubing pushed over the tail pipes when the engine is tested on test stands or dynamometers.

It is, therefore, recommended to remove the tail pipes prior to such tests.



## Heating

In order to insure satisfactory operation of the Volkswagen heating system, the following points should be observed:

- a - Make sure the heating control linkage is properly adjusted.
- b - To avoid excessive loss of heat, eliminate leaks in heating channels and body.
- c - Make sure the engine is free from oil leaks.
- d - Check for excessive pressure in crankcase (egress of oil at crankshaft fan pulley).
- e - Check for oil leaks at oil filler and breather tube.
- f - Check for leaks at flanges between exhaust pipes, muffler and pre-heating pipe.
- g - Check for obstructions in cooling air duct to engine.

An unsatisfactory heating system should be carefully examined and especially so in the case of unpleasant fumes in the heating air. This can be caused by dirty cylinder and cylinder head cooling fins or a dirty oil cooler. Besides the fact that a dirty engine causes the operating temperature to rise, which in turn can damage the engine, fumes may arise which can have a more or less unpleasant effect on the passengers in the car.

If during routine checks or repair work an engine is found to be very dirty, it should — with the customer's consent — be cleaned immediately.

The various ways of dealing with complaints of this nature have been dealt with in Workshop Manual, Section M, in Service Bulletin No. 40—KDT 7 — of 16. 10. 1954, and in Technical Bulletin Z/9.

## Gaskets for Exhaust and Pre-Heating Pipe Flanges

From Chassis No. 1524059 35,000 VW Engines are provided with iron-reinforced asbestos gaskets for the exhaust and pre-heating pipe flanges.

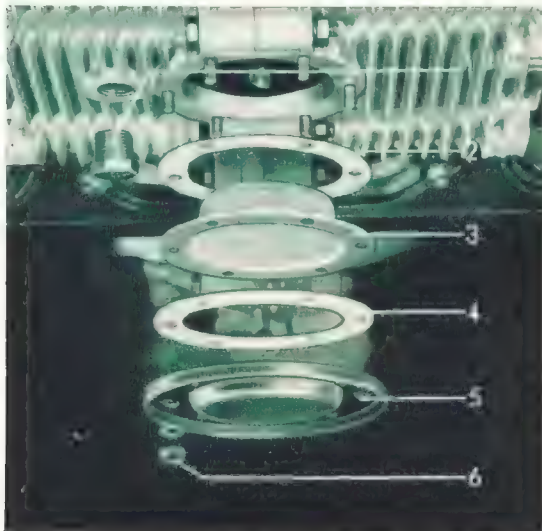
The new gaskets for the exhaust are provided with a 3 mm (.118'') thick bead, and those for the preheating pipe have an additional rim on the side pointing away from the engine besides the 3 mm (.118'') thick bead.

The purpose of this alteration is to improve the seal at the flanges.

## Removing and Installing Oil Strainer

### Removal

- 1 - Remove nuts on oil strainer bottom plate.
- 2 - Remove oil strainer bottom plate.
- 3 - Remove strainer and gaskets.



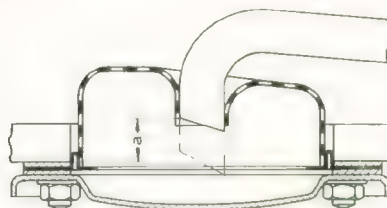
- 1 - Oil drain plug
- 2 - Gasket
- 3 - Strainer
- 4 - Gasket
- 5 - Bottom plate
- 6 - Nut

- 5 - Remove traces of old gasket from bottom plate contact face. Straighten bent or distorted bottom plates. Only a perfectly even contact face insures a proper seal.

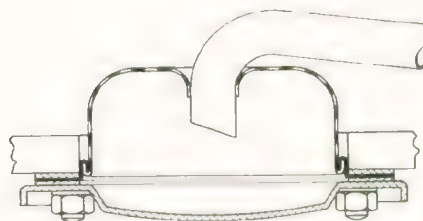
- 6 - Do not overtighten the nuts, especially when using thicker gaskets, to avoid bending the bottom plate.

### Note:

From Chassis No. 1191375 the oil suction pipe in the crankcase has been shortened by 12 mm/.47" (a = approx. 15 mm/.59").



From Chassis No. 1252842 the thickness of the oil strainer wire has been increased from 0.25 mm (.009") dia. to 0.26 mm (.010") dia., while the mesh has been enlarged.

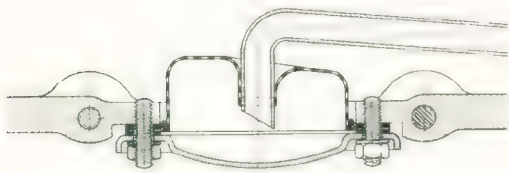


Earlier oil strainer: 16 meshes per 1 sq. cm.  
New oil strainer: 12 meshes per 1 sq. cm.

### Installation

Installation is a reversal of the above procedure, but the following notes should be observed:

- 1 - Check suction pipe for proper and tight seating.
- 2 - Clean strainer and remove traces of old gaskets.
- 3 - Renew gaskets.
- 4 - Reinstall the strainer so that its lower side comes to rest below the bend of the oil suction pipe and the opening of the strainer snugly embraces the pipe.



The strainer top is now parallel to the strainer flange, so that the only point to be observed when installing is to make sure that the strainer tightly embraces the oil suction pipe. Bend the strainer as found necessary to obtain a snug fit. The new strainer can also be used on engines of earlier dates.

This modification is to avoid a deformation of the strainer by the suction of the oil pump when a larger amount of sludge and dirt has accumulated.

With the engine disassembled the oil suction pipe can be shortened as follows:

- 1 - Clean right-hand half of crankcase and blow out with compressed air.
- 2 - Put clean rag over lower part of right-hand crankcase half below suction pipe.
- 3 - Shorten suction pipe so that it is 15 mm (.59").
- 4 - Remove any burr that might be apparent.
- 5 - Remove rag taking care that metal chips cannot fall into crankcase.
- 6 - Blow out crankcase and suction pipe with compressed air starting at oil pump bore.

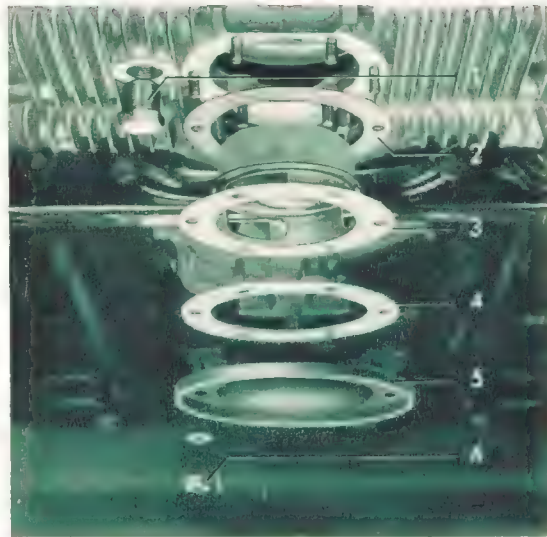
Never shorten oil suction pipe with the engine assembled as metal chips might fall into the crankcase, which cannot be cleaned satisfactorily by additional flushing.

From Chassis No. 1397440 with initial exceptions some modifications have been carried out on the oil suction pipe and oil strainer with a view to improving the oil circulation.

- 1 - A bell-shaped cap is soldered to the strainer as shown on the reverse side. This cap is to avoid the sucking in of air at a low oil level and if the oil is thick when starting in cold weather. Thus the cap insures a quick attaining of the full oil pressure under all operating conditions. Apart from the aforementioned advantages, the cap protects the oil strainer from foreign matter that will settle to the bottom of the crankcase.

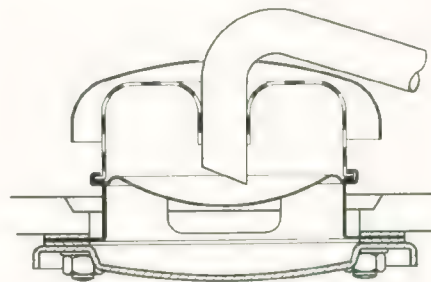
- 2 - The new oil strainer has a separated chamber for excluding any water.

The suction pipe intake being at a higher level, the new oil strainer will hold a greater amount of water and dirt than the earlier type.



#### Attention!

The new type oil strainer calls for a ring-shaped recess in the bottom of the crankcase. Hence, it can only be installed on crankcases that are provided with such a recess. Earlier oil strainers are not suitable for the modified crankcases.



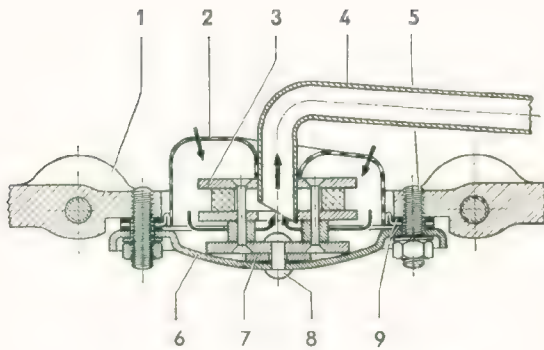
## Magneto-Mechanical Oil Filter

(Service Installation)

An improved method of removing abrasive particles and other impurities from the engine oil has been achieved by the newly designed Magneto-Mechanical Oil Filter. The magnetic filter is fitted to the center of the oil strainer plate so that it embraces the oil suction pipe. Thus, after the initial cleaning by the strainer, the oil must pass through

the magnetic system before it enters the lubrication system. The combination of the magnetic and mechanical filtering stops all ferrous abrasives. Additionally, foreign matter of nonferrous metals, carbon deposits, etc., will also be absorbed together with the ferrous abrasives due to the magnetic circuit.



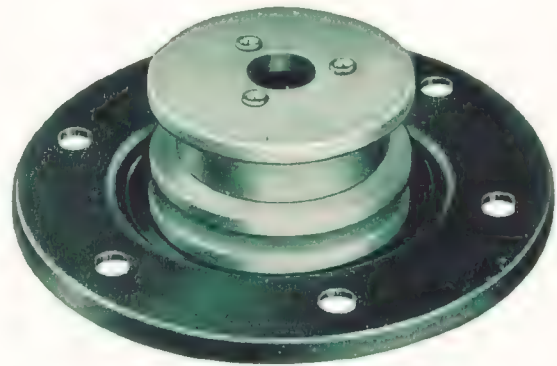


- |                      |                               |
|----------------------|-------------------------------|
| 1 - Crankcase        | 6 - Oil strainer bottom plate |
| 2 - Oil strainer     | 7 - Spacer washer             |
| 3 - Magnetic filter  | 8 - Rivet                     |
| 4 - Oil suction pipe | 9 - Gasket                    |
| 5 - Stud             |                               |

3 - To fill up the hollow space between magnetic filter and oil strainer plate, install a washer of an adequate thickness.

4 - Attach magnetic filter to oil strainer plate by means of a buttonhead rivet.

5 - Reinstall strainer and plate, using new gaskets. Check riveting for leaks.



### Installation

- 1 - Remove oil strainer plate, strainer and gaskets.
- 2 - Drill hole of 4 mm diam. (0.16'') into center of oil strainer plate.

## Removing and Installing Oil Pressure Relief Valve

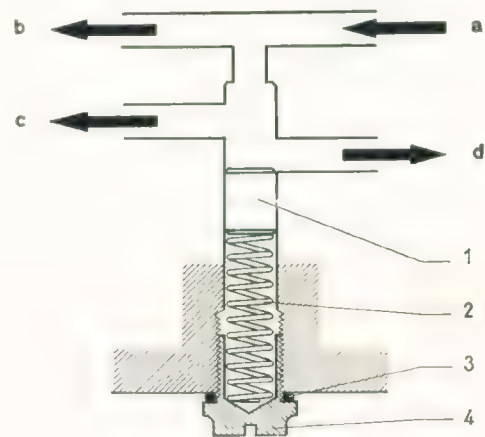
Check the oil pressure relief valve when disturbances in the oil circulation occur, especially when the oil cooler is leaky. The sketch below illustrates the operation of the valve.

The oil is fed

- a - from the oil pump,
- b - through the oil cooler to the lubrication points,
- c - directly to the lubrication points,
- d - to the oil sump.

### Oil Pressure Relief Valve (Schematic View)

- 1 - Plunger
- 2 - Spring
- 3 - Gasket
- 4 - Plug



## Removal

- 1 - Remove plug.
- 2 - Remove spring and plunger. A sticking plunger can be removed by screwing a tap M10 (10 mm metric thread) into it.

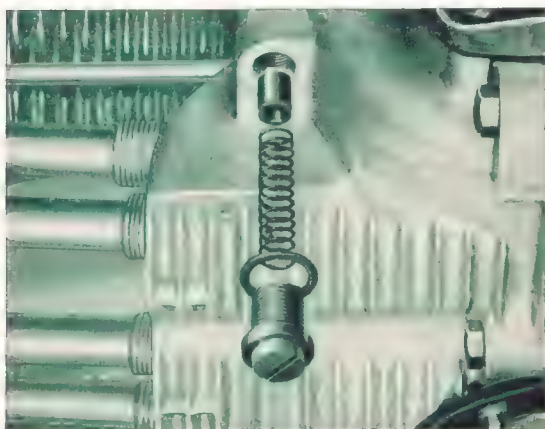
## Installation

Installation is accomplished by reversing the removal procedure, but the following notes should be observed:

- 1 - Check plunger and bore in crankcase for signs of seizure. Carefully remove signs of seizure, renew plunger if necessary.
- 2 - Examine spring.

Condition	Length	Load in kg
unloaded	53—1 (2.08''—0.04'')	0
assembled	39—1 (1.54''—0.04'')	$1.9 \pm 10\%$
loaded	30.5—1 (1.2''—0.04'')	$3.1 \pm 10\%$

- 3 - Make sure that the upper end of the spring does not scratch on the bore wall.
- 4 - Renew gasket.



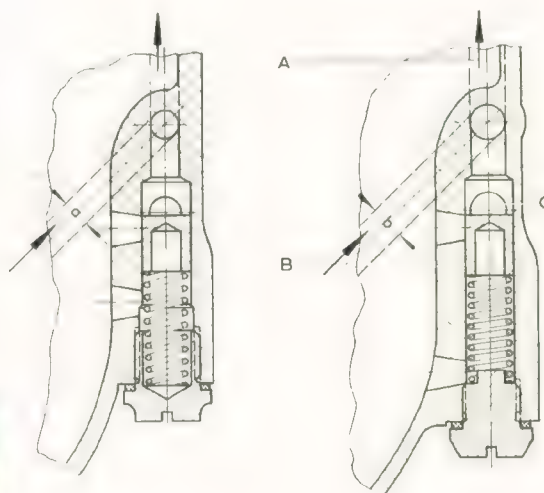
## Note:

From Chassis No. 1397440 with initial exceptions several improvements have been carried out on the crankcase concerning the oil circuit and crankshaft bearings.

1 - Modifications have been made on the oil pressure relief valve, i. e., bore for plunger spring and arrangement of oil channels. At the same time the drain hole for the oil, which, in small quantities can escape between plunger and bore wall, has been repositioned at the lowest point of the oil pressure relief valve. The hollow plug has been discarded previously in favor of a solid one. Accumulation of dirt and water is thus no longer possible. (To two versions are not interchangeable.)

2 - The diameter of the oil channels from oil pump to oil pressure relief valve (B), to oil cooler (A) and lubrication points (C) has been increased from 8 to 9 mm (.315'' to .354''). The oil bore, through which some of the oil is permitted to return direct to the oil sump, has been placed slightly lower.

The increased diameter bores result in a smoother flow of the oil, especially so when the engine is cold. By altering the position of the oil return bore it is intended to prevent a premature draining back of the oil, which, especially with the engine cold, is of great importance for an adequate lubrication of the bearing points.



A - to oil cooler, with engine having attained operating temperature, i. e., thin oil

hitherto 7.8 mm  $\varnothing$  (.307'')  
now 8.8 mm  $\varnothing$  (.346'')

B - from oil pump

a, b - oil bores

hitherto 8 mm  $\varnothing$  (.315'')  
now 9 mm  $\varnothing$  (.354'')

C - direct to lubrication points without passing through oil cooler

hitherto 7.8 mm  $\varnothing$  (.307'')  
now 8.8 mm  $\varnothing$  (.346'')

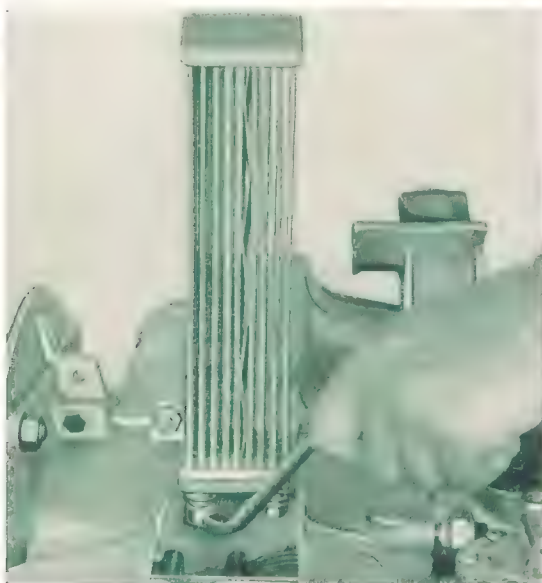
3 - The seat for main bearing No. 1 has been reinforced by additional ribs and strengthening of the crankcase.

## Oil Cooler Removal and Installation

(with engine in situ)

### Removal

- 1 - Remove rear hood and bracket.
- 2 - Remove fan housing.



### Note:

From Chassis No.1395146 the oil cooler has been provided with a prop.

The prop is screwed to a bracket welded to the top of the cooler. A 2 mm washer (outer diameter 24 mm/.94") is placed between the prop and the fan housing. The bottom end of the prop is held by the first crankcase screw.

The upper end of the prop is to be detached from the oil cooler whenever removing the fan housing.

- 3 - Remove oil cooler retaining nuts by means of a 10 mm box wrench VW 109.
- 4 - Remove oil cooler and rubber seals.

### Installation

Installation is a reversal of the above operations, but the following points should be observed:

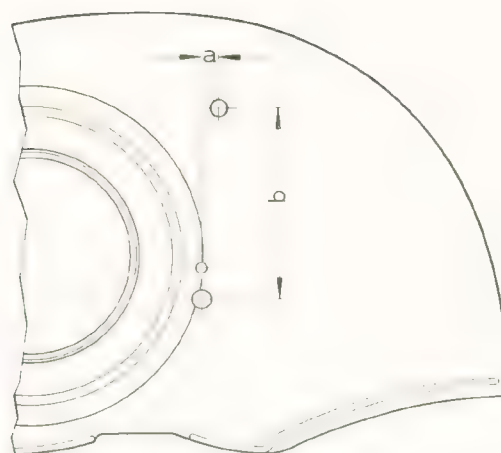
- 1 - Check oil cooler for leaks at a pressure of 6 kg/sq. cm (85 lbs./sq. in.) and see to it that the nuts and the retaining bracket are tight.
- 2 - In the event of a leaky oil cooler, check oil pressure relief valve.
- 3 - The hollow ribs of the oil cooler should not touch one another and the partition sheet should not be loose.
- 4 - Use new rubber seals.







The modified oil cooler can be installed on all earlier engines, after the fan housing has been provided with a hole for the prop fixing screw as specified on the drawing to the right.



$a = 13.5 \text{ mm } (.531'')$   
 $b = 146 \text{ mm } (5.75'')$   
 Hole diameter =  $12 \text{ mm } (.47'')$

This prop keeps the oil cooler free from vibrations, resulting in a longer life of the latter.

### Oil cooler

From Chassis No.: 1655524.

Intermittently from Chassis No.: 1536250

Oil coolers in engines of VW Passenger Cars brazed.

### The following modifications have been carried out:

The oil cooler prop is omitted.

The same applies to the prop bore in the fan housing.

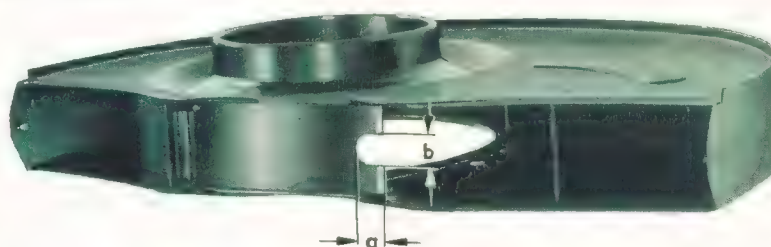
The lower baffle plate in the fan housing has been provided with a cutout to prevent the plate from resting on the modified nut which serves to mount the oil cooler on the crankcase. The nut has been modified only to facilitate assembly during production. In the event of repairs the nut used so far may, of course, be fitted together with the corrugated washer.

The height of the oil cooler has been reduced from 254 mm (10'') to 226.5 mm (8.917'') while the number of oil tubes is now 32 as against 36 previously.

For protection, the new oil coolers are painted black. Thus they can easily be distinguished from the soldered coolers.

### Attention.

When mounting a fan housing of older design on an engine fitted with a brazed oil cooler, first provide a cutout in the lower baffle.



$a = 20 \text{ mm } (25/32'')$

$b = 20 \text{ mm } (25/32'')$

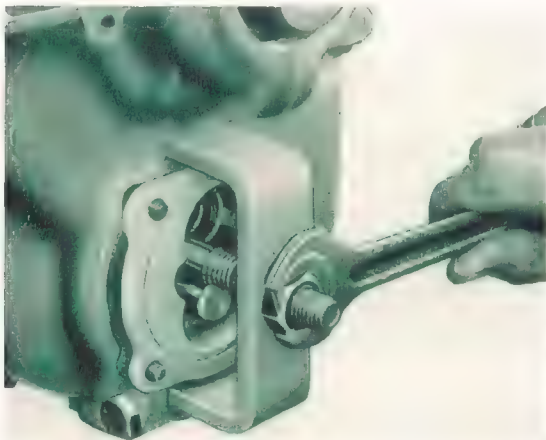
When using a fan housing with an oil cooler prop bore, enlarge the bore to 15 mm (19/32'') diameter and then close it with a rubber plug.

## Removing and Installing Oil Pump

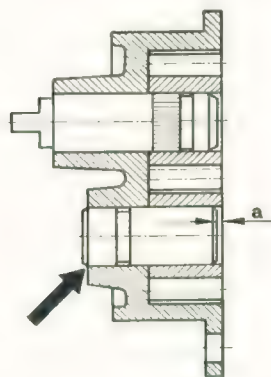
(with engine in situ)

### Removal

- 1 - Remove engine rear cover plate.
- 2 - Remove fan pulley.
- 3 - Remove pulley cover.
- 4 - Remove nuts on oil pump cover and take off cover and gasket.
- 5 - Remove the gears.
- 6 - Remove oil pump body by means of the extractor VW 201.



- 3 - Check idler gear pin for looseness and, if necessary,peen it securely in position, or replace pump body ( $a = 0.5\text{--}1.0\text{ mm}/0.02''\text{--}0.04''$ ).

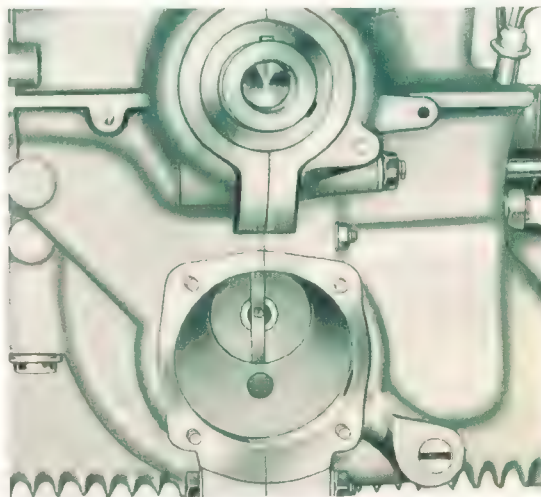


- 4 - Examine oil pump mating surface on crankcase for accumulation of dirt.
- 5 - Turn crankshaft until the slot in the camshaft is vertical, that is, parallel to the crankcase jointing faces.

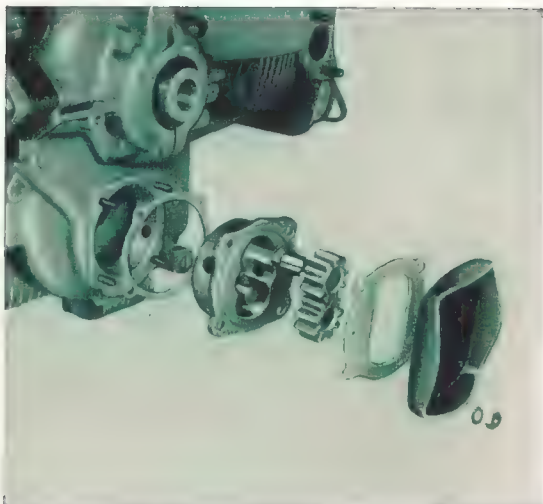
### Installation

Installation is a reversal of the preceding operations, but the following points should be noted:

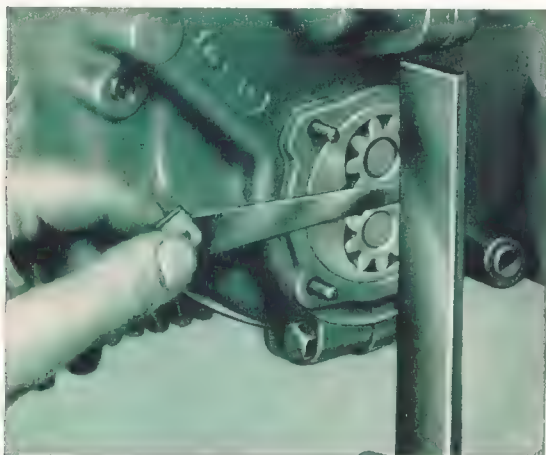
- 1 - Check oil pump body for wear, especially the gear contact points, prior to assembly. Loss of pressure will be the result of excessive wear in the pump body.
- 2 - Examine gears for wear.  
Backlash: 0.03—0.08 mm (0.0012—0.0031'').  
End play with cover removed: 0.066—0.183 mm (0.0026—0.0072'').  
Wear limit: 0.20 mm (0.0079'').



- 6 - Insert oil pump body, gasket, and gears.



- 7 - Place a straight edge across the oil pump body and check the clearance between the straight edge and the gears either visually or by means of a feeler gauge. The clearance should never be in excess of 0.1 mm (0.004") with the gasket removed.

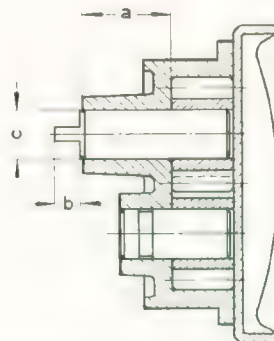


If the cover is worn from contact with the gears, plane it off evenly.

- 8 - Turn camshaft 360 degrees (one complete turn) = two turns of the crankshaft. By doing this, the oil pump shaft is properly centered to the slot in the camshaft.
- 9 - Use new VW gaskets (0.08 mm) without sealing compound. When tightening the nuts, make sure that the position of the oil pump body is not disturbed.

#### Note:

From Chassis No. 1294549 the bore accepting the oil pump drive shaft is 2 mm (.08") longer. Coupled with this modification is a reduction in the clearance of the pump drive shaft and the use of aluminium alloy for the oil pump body.



- a - Length of bore: earlier 23 mm  
now 25 mm
- b - Length of drive shaft tongue: earlier 10.2—0.5 mm  
now 8 —0.5 mm
- c - Diameter of bore: earlier 14.077—14.050 mm ∅  
now 14.068—14.050 mm ∅

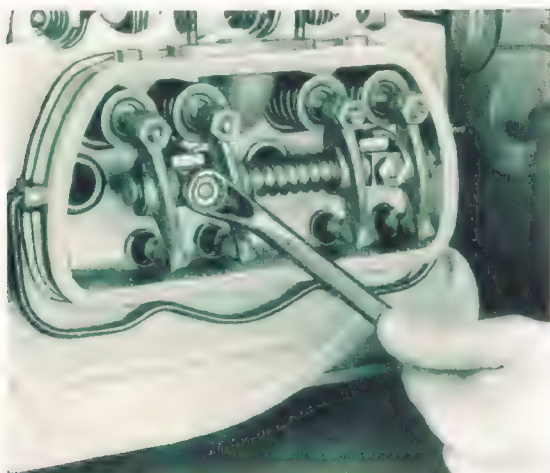
These modifications make the oil pump more wear resistant. The new parts are interchangeable with those used before.



## Removing and Installing Valve Rocker Mechanism

### Removal

- 1 - Remove cylinder head cover.
- 2 - Remove rocker arm shaft retaining nuts.



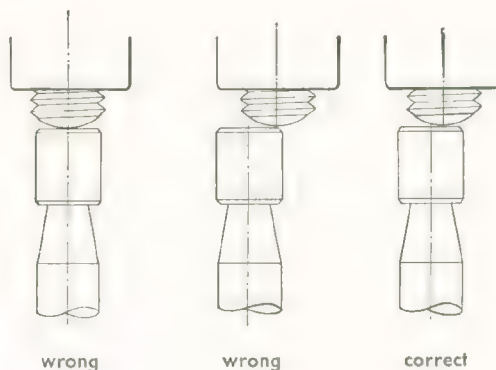
- 3 - Remove rocker arm shaft and rocker arms.

### Installation

Installation is a reversal of the above procedure, but the following points should be noted:

- 1 - The ball ends of the valve push rods must rest centrally in the sockets of the rocker arms to avoid jamming of the push rods in their guides.
- 2 - To obtain a rotation of the valves, the rocker arm adjusting screws should contact the valve stem somewhat out of center (displaced to the right).

Wear on the stem face and a forming of deposits on the valve seating faces are thus reduced by the gradual turning of the valve.



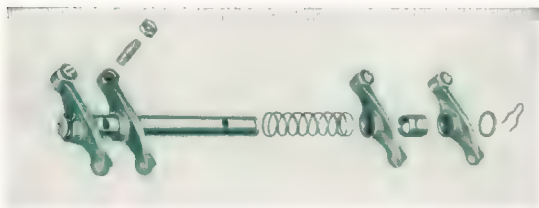
When conducting service inspections, or in assembly, attention should be paid to the above described position of the adjusting screws on the valve stems. This position can be reached by moving the rocker arm shaft sideways in its clearance holes for the studs prior to tightening the nuts. If necessary, the length of the rocker arm spacers or the thickness of the washers should be altered or additional washers fitted to obtain the offset.

- 3 - Adjust the valves.
- 4 - Reinstall cylinder head cover, using a new gasket. The gasket is to be glued to the cover.

## Disassembly and Assembly of Rocker Arm Mechanism

### Disassembly

- 1 - Remove spring clips from rocker arm shaft.
- 2 - Remove washers, rocker arms, spacer tube, and spring.



### Assembly

Reassembly is a reversal of the above procedure, but the following notes should be observed:

- 1 - Check rocker arm shaft for wear.
- 2 - Examine seats and ball sockets of rocker arms and valve adjusting screws for wear.
- 3 - Loosen adjusting screws prior to installing rocker arms.

## Removing and Installing Cylinder Head

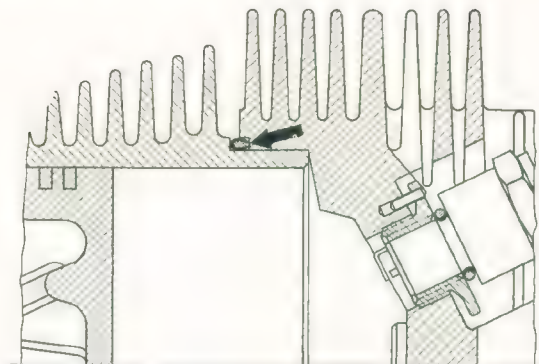
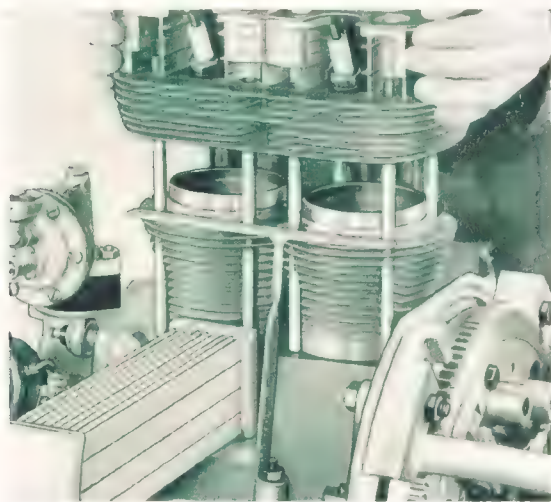
### Removal

- 1 - Remove cylinder head cover.
- 2 - Remove rocker arm shaft retaining nuts.
- 3 - Remove rocker arm shaft and rocker arms.
- 4 - Remove cylinder head nuts using a 10 mm hex. key.

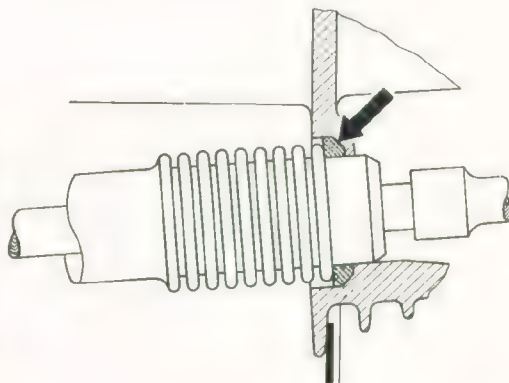
#### Note:

From Chassis No. 1-0029746 onwards, 15 mm nuts (across flats) are used for attaching the cylinder heads. They are removed and tightened by means of the socket wrench VW 165.

- 5 - Screw off thermostat and remove link rod.
- 6 - Lift off cylinder head.  
If it is intended to remove the cylinder heads only, the cylinder retainer VW 650 (local manufacture) prevents the cylinders from being withdrawn together with the head, thus avoiding ingress of dirt.



- 3 - When installing cylinder head, make sure that the oil seals at the ends of the push rod tube are properly seated. The press seam of the oil seal must not bear on the seating surface. The oil seal has a trapeziform cross section.



- 4 - Bent sealing sleeves for the lower cylinder head nuts can be straightened with the tool VW 660 (local manufacture).

### Installation

Installation is a reversal of the above operations, but the following hints should be noted:

- 1 - There is no gasket between upper edge of cylinder and the corresponding contact surface in cylinder head with the exception of "re-conditioned cylinder heads".
- 2 - Renew gasket between shoulder of cylinder and cylinder head.

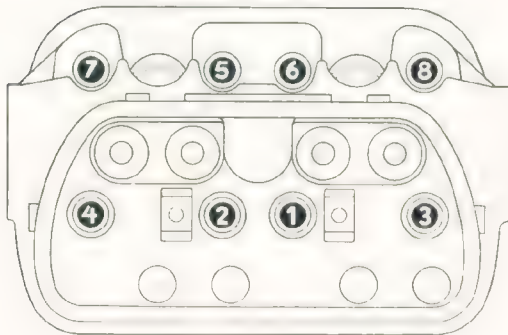


- 5 - Dip gaskets under cylinder head nut sealing sleeves into oil before installation.

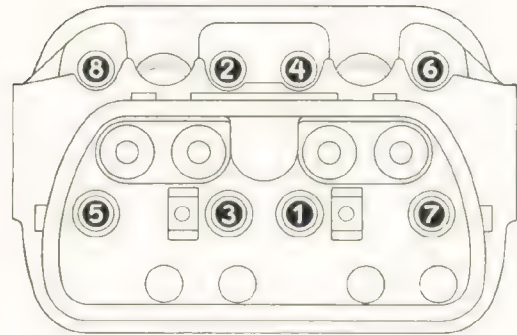
**Note:**

From Chassis No. 0929746, a washer is used for each cylinder head nut.

- 6 - Coat cylinder head nuts with graphite paste and screw them down until resistance can be felt. Tighten to 1 mkg (7 ft. lbs.) by means of a torque wrench in the order indicated on the drawing below.



- 7 - Fully tighten to 3.6—3.8 mkg (26—27 ft. lbs.) torque in the following order:



- 8 - Reinstall rocker arm shaft and rocker arms. Take care that the ball ends of the valve push rods fit centrally in the rocker arm sockets to avoid jamming of the push rods in their guides.

- 9 - Adjust valve play.

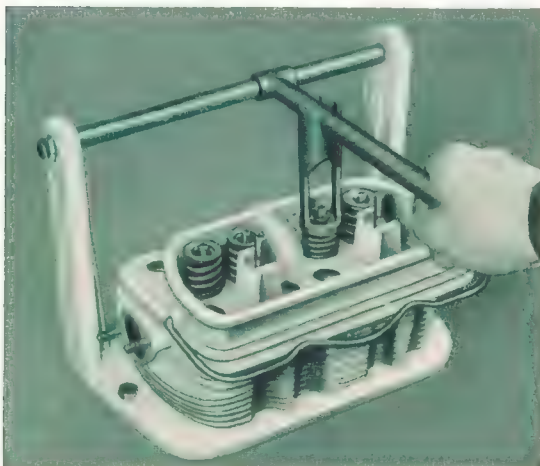
- 10 - Install cylinder head cover, using a new gasket. The gasket is to be cemented to the cover.

- 11 - Grease operating shaft of automatic cooling air control with Special Grease VW—A 051.

## Removing and Installing Valves

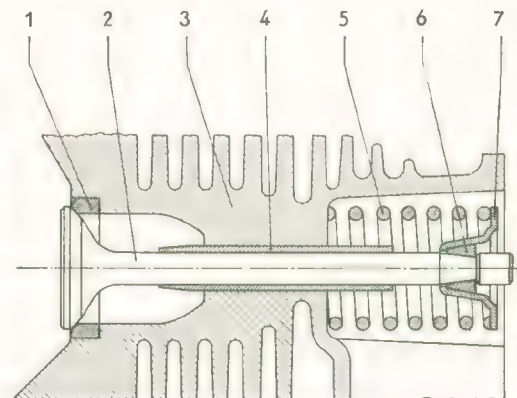
### Removal

- 1 - Remove cylinder head.
- 2 - Place cylinder head in valve extractor VW 311, press down valve spring seat, remove valve cotters and valve spring seat.



- 3 - Remove valve springs.

- 4 - Extract valves.

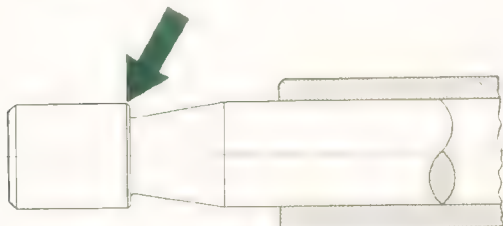


- 1 - Valve seat insert  
2 - Valve  
3 - Cylinder head  
4 - Valve guide

- 5 - Valve spring  
6 - Valve cotter  
7 - Valve spring seat



The shoulder of the cotters is likely to become feather-edged after a longer period of operation.



After the burr has been removed with a smoothing file, the valve can be extracted from its guide.

### Installation

Installation is a reversal of the preceding operations, but the following points require attention:

- 1 - Test valve spring.

Conditions	Length	Load
Free length	43 mm (1.69'')	0
Loaded length	28 mm (1.10'')	33.4 kg $\pm$ 5%

A maximum loss of load of 10% on used springs is permissible.

- 2 - Check valve cotters prior to assembly.



- 3 - Check valve stem for run-out (Max. permissible run-out 0.01 mm = 0.0004'').
- 4 - Examine valve guides for wear.
- 5 - Examine valves for wear and check fit of valves in valve seats. Rough valve stems should be polished carefully with a very fine emery cloth.

### Valve Springs

The wear-and-tear limit of the valve springs has been reduced **from 30 kg to 28 kg** at a loaded length of 28 mm (1.10'').

This does away with unnecessary or premature replacing of the springs. The service life of the parts connected with the springs is not affected.

## Testing Valve Seats

The valve seat must be concentric with the valve guide. A check is carried out by means of the marking gauge in the Valve Grinding Kit VW 311 b.

- 1 - Spread a thin film of prussian blue (engineers' marking) on the contact surface of the gauge.
- 2 - Insert pilot into valve guide and turn the gauge with light pressure one quarter turn in to the valve seat.
- 3 - Check valve seat. If the blue does not transfer evenly to the valve seat, the seat is to be refaced.



## Checking Valve Guides

A replacement of the valve guides is not possible with the tools and appliances which are available in a workshop, as the guides are shrunk (chilled) into position by means of liquid air. The drifting out of the old guides is, therefore, liable to result in damage to the cylinder head.

To remove deposits, use a broach driven through the guides. The broach is clamped into a press or guide.

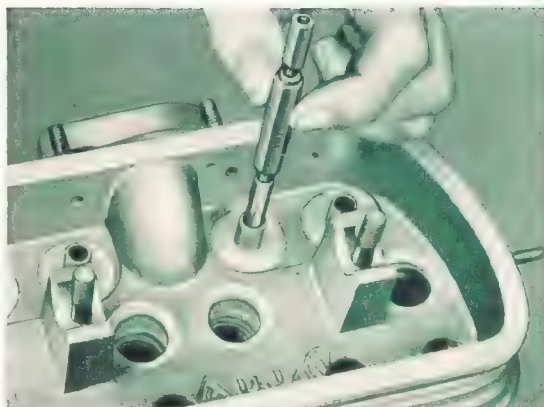
The broach should not be allowed to revolve when passing through the guide.

If the clearance should be near the wear limit of 0.15 mm (0.0059'') for the intake valve and 0.16 mm (0.0063'') for the exhaust valve, the cylinder is to be replaced by a new or reconditioned one.

A check is carried out with the Plug Gauge VW 253 after the valve guide has been cleaned from deposits that may have accumulated.

This is best done by a broach driven through the guides. The broach is clamped in a press or drill chuck and gradually forced through the guide, without being allowed to revolve.

Valve guide	Dimensions
Intake	7.008 dia. H 7 (0.2759'')
Exhaust	7.023 dia. H 7 (0.2765'')

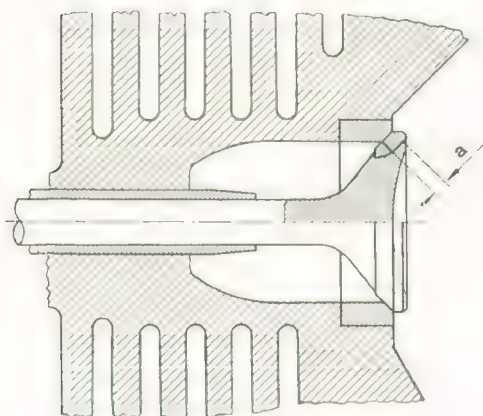


## Refacing Valve Seat Inserts

Damaged or burnt inserts may be reconditioned by means of a seat cutter of 45° as long as the specified width of the seat face is maintained and the outer edge of the 15° chamfer does not exceed the outer diameter of the valve seat insert.

Seat width (a):

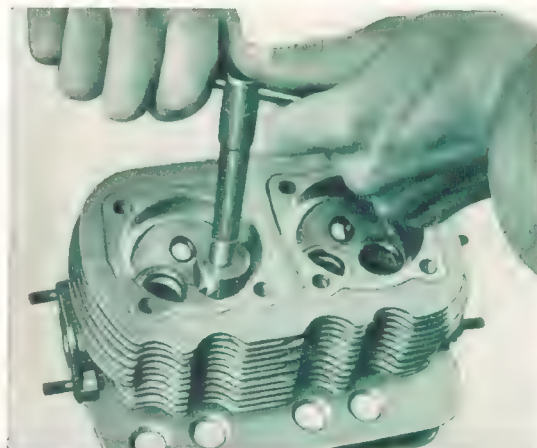
Intake: 1.3—1.6 mm (0.051—0.063'')  
Exhaust: 1.7—2.0 mm (0.067—0.079'')



If the chamfer exceeds the outer diameter of the seat insert, the cylinder head is to be replaced by a new or reconditioned one. A replacement of the inserts is beyond the scope of a workshop, as they are shrunk (chilled) into position by means of liquid air.

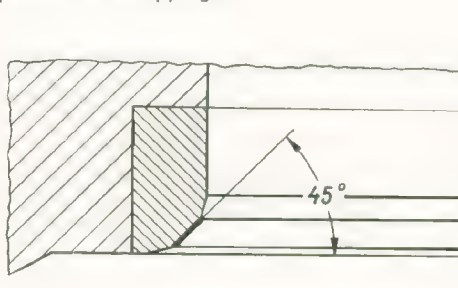
The cutters required for reconditioning the valve seat inserts will be found in the Valve Grinding Kit VW 311 b.

Steel inserts must be reground to obtain a new face.

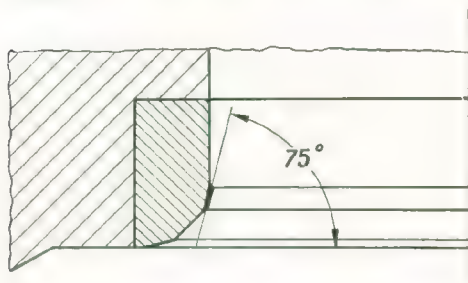


### Sequence of operations

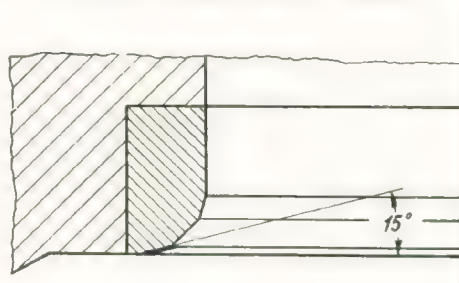
- 1 - Cut the 45° seat face. Considerable care must be taken when cutting to obtain a concentric seating surface clear of chatter marks. It is important to exert the pressure exactly vertically. Take off only the minimum of metal required to clean up the seat face to avoid a premature scrapping.



2 - Cut the 75° face: Slightly chamfer the lower edge of the valve seat face by means of the cutter.

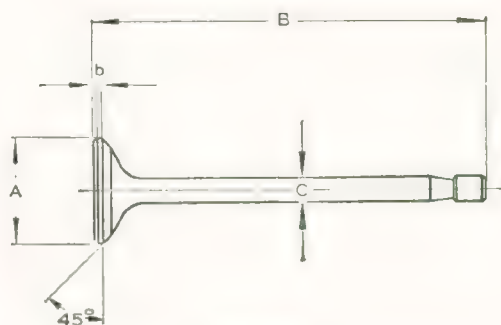
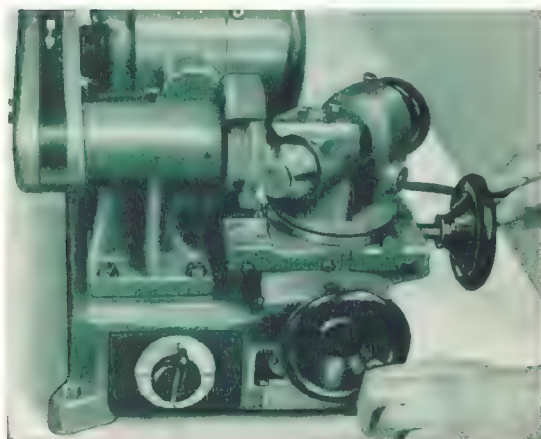


3 - Cut the 15° face: Chamfer the upper edge of the valve seat face by means of the 15° cutter until the correct seat width is reached.



## Refacing Valves

No attempt should be made to lap badly pitted valves into their seats, they should be refaced with a valve refacing machine.



### Intake Valve

A =	29.9	—	30.1	mm	(1.177"	—	1.185")
B =	101.7	—	102.3	mm	(4.004"	—	4.023")
C =	6.955	—	6.965	mm	(0.2738"	—	0.2742")
b =	1.10	—	1.60	mm	(0.043"	—	0.063")

### Exhaust Valve

A =	27.9	—	28.1	mm	(1.098"	—	1.106")
B =	101.7	—	102.3	mm	(4.004"	—	4.023")
C =	6.945	—	6.955	mm	(0.2734"	—	0.2738")
b =	1.10	—	1.60	mm	(0.043"	—	0.063")

## Lapping (Grinding-in) Valves

Rotate the valves on their seats by means of a valve grinding tool.

The Chuck VW 311 c, or the tool in the Valve Grinding Kit VW 311 b may be used for this purpose. Frequently raise the valve and revolve it no more than a few degrees, or rings will form on the faces.

After grinding, thoroughly clean off all traces of grinding compound.





## Inspecting Valves

- 1 - Thoroughly clean the valves of all traces of carbon, using a wire brush.
- 2 - Examine valve faces for wear and burns. Reface them if necessary.

Seat width	Intake valve	1.3—1.6 mm (0.051—0.063'')
	Exhaust valve	1.7—2.0 mm (0.067—0.079'')

Considering the high thermal stress imposed on the exhaust valves, it is important not to reduce

the dimension "b" of the valve head more than specified.

If the valve face is badly burnt or pitted, the valve should be replaced.

- 3 - Valves having pitted stem faces must be replaced.
- 4 - Discard all valves showing a warped stem, signs of seizure, or a damaged valve cotter seat. No attempt should be made to straighten or grind valve stems.

## Checking Fit of Valve in Valve Seat

With the use of new valves and accurately refaced seats, grinding-in (lapping) is not always necessary. A simple check can be made by applying prussian blue.

- 1 - Lightly coat the valve face with prussian blue.

- 2 - Insert valve into valve seat and, with light hand pressure, rotate the valve a quarter of a turn.

- 3 - Lift off the valve. If the valve is correctly seating, the blue should be completely reproduced on the valve seat face. If necessary, grind (lap) the valves.

## Valve Adjustment and Valve Timing

An inspection or adjustment of the valves must only be carried out with the engine cold and at moderate outside temperature (approx. 20 °C = 68 °F).

### Valve clearance:

Intake	0.10 mm (0.004'')
Exhaust	0.10 mm (0.004'')

The clearance increases when the engine warms up. It should carefully be checked at the prescribed intervals.

### Valve clearance insufficient:

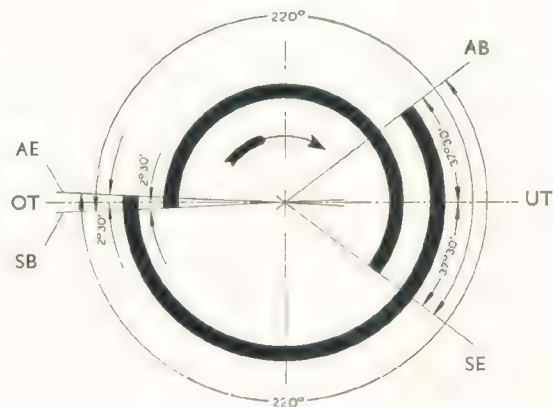
- Burning of valves and valve seats.
- Distortion of valves.
- Poor performance by reduced compression.
- Uneven engine running.
- Unsteady valve timing.

### Valve clearance excessive:

- Noisy timing mechanism.
- Uneven engine running.
- Unsteady valve timing.

Valve adjustment gives the desired result only if:

- the valves tightly seal, there is no undue clearance in the valve guides, and the stem face is not pitted.



Valve Timing Diagram

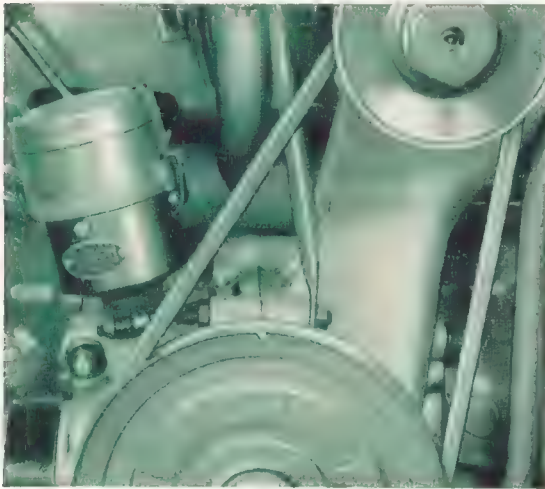
Intake opens	SB	2°30' before T.D.C.
Intake closes	SE	37°30' after B.D.C.
Exhaust opens	AB	37°30' before B.D.C.
Exhaust closes	AE	2°30' after T.D.C.

This diagram applies to a valve clearance of 1 mm (0.04'') with the engine cold. After having checked the valve timing, the normal valve clearance of 0.1 mm (0.004'') should be restored. A reduction of the clearance by 0.01 mm (0.0004'') increases angles by 3° each.

## Adjusting Valves

Valve adjustment is best be effected in the following sequence: 1st—2nd—3rd—4th cylinder. Adjust the valves when the piston of the corresponding cylinder is on top dead center position of the compression stroke, as the two valves are then closed.

Starting with the 1st cylinder, crank the engine over slowly to the left at the fan pulley, until both valves are in fully closed position and the timing mark on the pulley is in line with the vertical jointing faces of the crankcase.



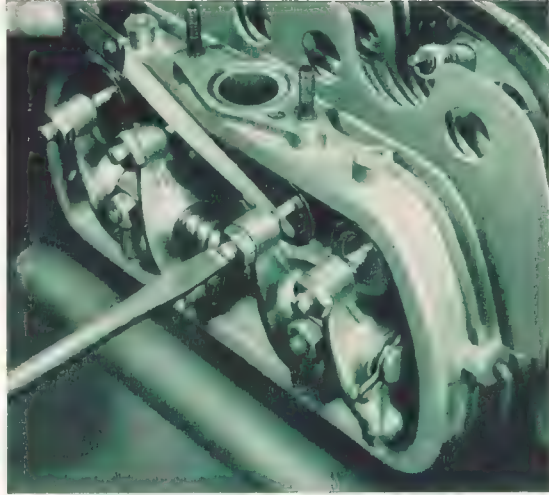
1 - Remove cylinder head cover.

2 - Set engine to the firing position of the cylinder to be adjusted.

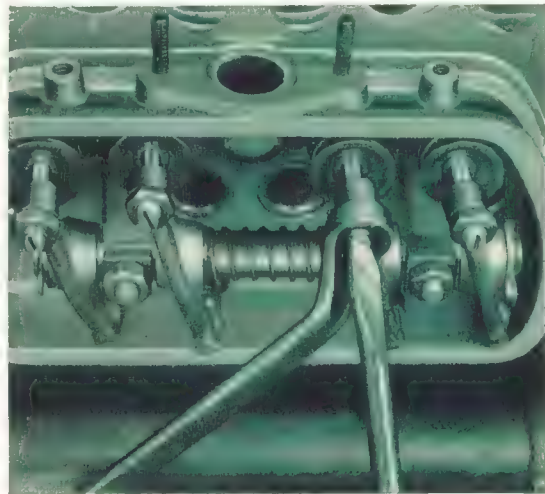
3 - Check valve clearance with a feeler gauge 0.10 mm (0.004'').

4 - Loosen lock nut of the adjusting screw.

5 - Turn adjusting screw as required to obtain the proper clearance.



6 - Hold adjusting screw with screwdriver while tightening lock nut.



7 - Recheck adjustment.

8 - Check and adjust the other valves in the same manner by turning the crankshaft anticlockwise another 180° for each cylinder.

9 - Replace cylinder head cover, using a gasket which is in good condition.

## Reconditioned Cylinder Heads

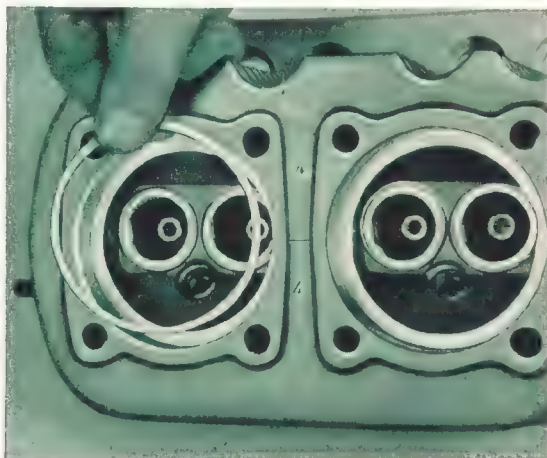
There is no gasket between the mating faces of the cylinder and the cylinder head.

Cylinder heads reconditioned by the factory are remachined at the mating surfaces, if these are found to be damaged.

The cylinder seating depth — standard 12.9—

13.0 mm (0.507—0.512'') — is then increased by 0.4, 0.8, 1.0, or 1.5 mm (0.0157, 0.0314, 0.0393, or 0.0590''). A remachining up to 1.0 or 1.5 mm (0.0393 or 0.0590'') becomes rarely necessary. The difference of the seating depths in one cylinder head must not be in excess of 0.1 mm (0.004'')

The amount of remachining is marked between the cylinder seats of each cylinder by  $\frac{1}{10}$  mm (tenths of a millimeter), for example: 4, 8, 10 or 15.



These cylinder heads are to be fitted with shims compensating the amount of remachining. The shims are delivered in the thicknesses: 0.4, 0.8, 1.0, 1.5 mm (0.0157, 0.0314, 0.0393, or 0.0590"). To insure a square seating of the cylinder head, the compensating shims of one head must, of course, be of the same thickness. A falling out of the shims when fitting the cylinder head is prevented by applying a little grease on the seating surface prior to assembly.

To maintain the proper compression ratio of reground cylinders, the corresponding oversize pistons (77.5 or 78.0 mm  $\varnothing$ ) are lower than the standard pistons (distance from piston top to piston pin hole). Compensating shims should in this connection only be fitted, if remachined cylinder heads are used at the same time.

Prior to installing reconditioned cylinder heads, the valves must be ground (lapped) and checked for a proper fit in the valve seats.



## Removing and Installing Cylinders

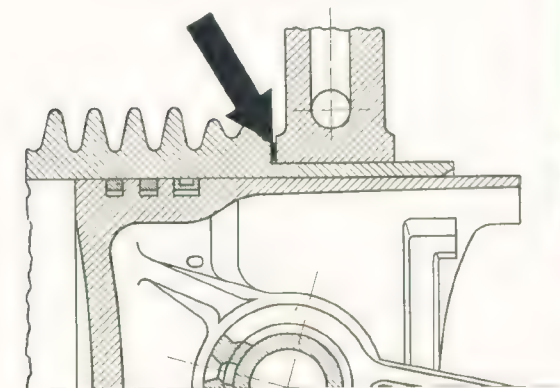
### Removal

- 1 - Remove cylinder head.
- 2 - Remove valve push rods and valve push rod tubes.
- 3 - Remove deflector plate below the cylinders.
- 4 - Take off cylinders.

### Installation

Reverse the preceding operations while observing the following points:

- 1 - Check cylinder for wear and, if necessary, replace by another matched pair of cylinder and piston of the same size.
- 2 - Cylinder seating surface on crankcase, cylinder shoulder, and gasket must be perfectly clean. Foreign matter at this point may cause distortion of cylinder.



- 3 - Always use new gasket between cylinder and crankcase.
- 4 - Apply some oil to piston and piston pin.
- 5 - Compress the rings by means of the compressing tool VW 123 a. Ring gaps must be staggered so that they are not in line vertically. The oil ring gap must always be at the top when the pistons are in their horizontal position in the engine.



- 6 - Oil the cylinder wall and slide the cylinder over the piston. The crankcase studs must not contact the cylinder cooling fins.

## Inspecting Cylinders

An inspection of the cylinders is carried out by means of a dial gauge for inside diameters and gauge rings corresponding with the cylinder sizes.

Cylinder	Gauge ring
75.0 mm	VW 252 a
75.5 mm	VW 252 b
76.0 mm	VW 252 c

The fitting clearance between cylinder and piston amounts to 0.035—0.055 mm (0.0014—0.0022").

The selective assembly of cylinders and pistons is greatly facilitated by the following scheme:

Permissible wear limit:

Clearance cylinder/piston	max. 0.20 mm (0.008")
Cylinder out-of-round	max. 0.01 mm (0.0004")

The clearance must not be checked with a feeler gauge, but should be determined by measuring cylinder and piston.

The cylinder should be measured 10—15 mm (0.4—0.6") below the upper edge. Cylinders which are nearly or completely worn to the specified wear limit must be replaced together with the corresponding pistons by those of the same size. The cylinders and pistons in one engine must be of the same size.

Apart from wear, the oil consumption of the engine is an important factor in deciding whether or not a new cylinder and piston must be installed. If the oil consumption is in excess of 1 liter per 1000 km (0.26 U. S. gals per 620 miles) the engine needs an overhaul.

An oil of a higher viscosity, for example SAE 30, can be used during the warmer season with engines having a marked oil consumption.



From Chassis No. 1597047.

Cylinders of all VW engines have been provided with a 8 mm (.3149") shorter working surface. This measurement applies to that part of the cylinder which protrudes from the cylinder seating surface into the crankcase. This alteration results in improved breathing of the crankcase.

Cylinders of previous design can be exchanged for cylinders of new design.

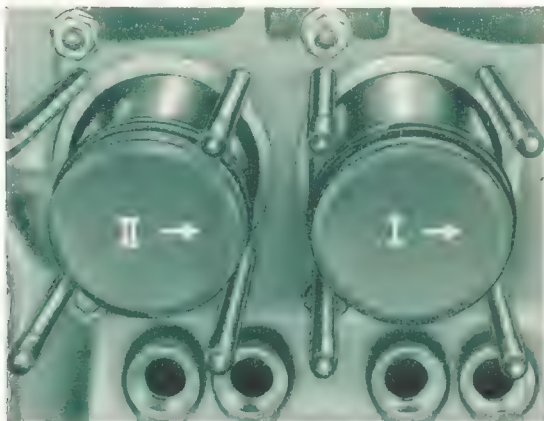
#### Dimensions and Grading Marks of Cylinders

	Colour	Cylinder mm dia.	Corresponding Piston mm dia.
Standard Size	Blue	74.990—76.999	74.95
	Pink	75.000—75.009	74.96
	Green	75.010—75.020	74.97
1st Oversize	Blue	75.490—75.499	75.45
	Pink	75.500—75.509	75.46
	Green	75.510—75.520	75.47
2nd Oversize	Blue	75.990—75.999	75.95
	Pink	76.000—76.009	75.96
	Green	76.010—76.020	75.97

## Removing and Installing Pistons

### Removal

- 1 - Remove cylinder.
- 2 - Mark the piston to make sure that it is reinstalled in original position.



- 3 - Remove piston pin circlip, using circlip pliers VW 122 b.
- 4 - Heat the piston to 80 °C (176 °F) with Electric Piston Heating Tool VW 205.



- 5 - Remove piston pin, using pilot drift VW 207 or tool VW 207 a.
- 6 - Remove piston rings, if required, by means of the piston ring tool. The piston rings should, if possible, remain on the piston to avoid damage.



### Installation

Reverse the removal procedure while observing the following points:

- 1 - Check connecting rod alignment, using gauge VW 250.
- 2 - Clean piston. Remove carbon from piston tops and piston ring grooves. No sharp instruments must be used in order not to damage the metallic surface. Do not use emery cloth to remove carbon from piston skirts (if necessary, use a fine corundum stone with oil). If the piston does not bear squarely on the cylinder wall, this can be seen on the skirt, especially by a one-sided forming of carbon deposits, indicating a twisted connecting rod.
- 3 - Check and measure pistons. The nominal diameter is stamped on the piston top. The reading must be taken at the bottom end of the skirt parallel to the piston pin axis.





## Dimensions, Weights, and Grade Marking of Pistons

Size Grading				
	Blue	Paint Dot Pink	Green	
Standard Size 75.0 mm $\varnothing$	74.95 mm $\varnothing$	74.96 mm $\varnothing$	74.97 mm $\varnothing$	
1st Oversize 75.5 mm $\varnothing$	75.45 mm $\varnothing$	75.46 mm $\varnothing$	75.47 mm $\varnothing$	
2nd Oversize 76.0 mm $\varnothing$	75.95 mm $\varnothing$	75.96 mm $\varnothing$	75.97 mm $\varnothing$	

Weight Grading	
Paint Line	Weight
Brown	250—260 grammes
Grey	260—270 grammes

The fitting clearance between piston and cylinder is 0.035—0.055 mm (0.0014—0.0022"). If, on measuring the piston and the corresponding cylinder, it is found that the clearance is near the amount of 0.20 mm (0.008"), replace piston and cylinder by another pair of the same size and weight grading. The piston must not be fitted separately, if the corresponding cylinder shows signs of wear.

If the corresponding cylinder of a damaged piston does not show any signs of wear, it is often sufficient to fit a new piston of the same size and weight grading.

- 4 - Check gap clearance with a feeler gauge after the ring has been inserted in the cylinder and squarely pushed down about 5 mm (0.2") by the piston.



### Marking of pistons

- 1 - Grade of size.
- 2 - Grade of size marked by paint dot.
- 3 - The arrow and the word "vorn" must point towards the flywheel when installing the piston.
- 4 - Grade of weight marked by paint line.
- 5 - Grade of weight marked by symbols.

Grey = + weight.

Brown = - weight.



Gap clearance of all three rings:  
0.30—0.45 mm (0.012—0.017"); max. 0.95 mm (0.037").

When reinstalling cylinder, be sure that no ring gaps are in line. The gap of the oil scraper ring must always be at the top.

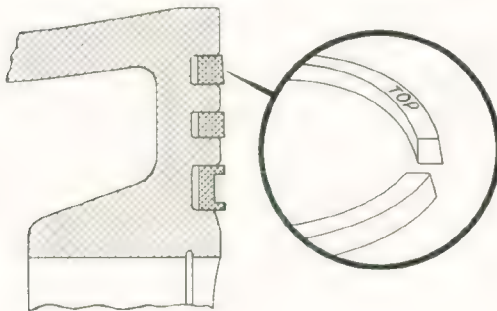
Check piston ring side clearance in grooves using a feeler gauge when the piston is in its horizontal position in the engine.

Compression ring	Oil ring
0.035—0.062 mm; max. 0.1 mm (0.0014—0.0024"; max. 0.004").	0.025—0.052 mm; max. 0.1 mm (0.001—0.002"; max. 0.004").



The rings must only be installed by means of the piston ring tool to avoid damage to the piston and overstraining or fracture of the rings.

Make sure that the upper compression ring is installed with the marking "Top" or "Oben" on the ring toward the top of the piston.



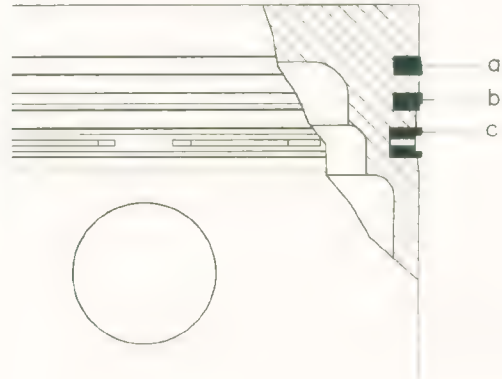
#### Note:

The following piston ring sets are available for service installation in engines having an excessively high oil consumption:

Engine	Bore	Part No.
1131 c. c.	75 mm	SP 101 A
	75.5 mm	SP 105 A
	76 mm	SP 109 A
1192 c. c.	77 mm	SP 103 A
	77.5 mm	SP 107 A
	78 mm	SP 111 A

The installation of these special piston ring sets is justified if

- 1 - the oil consumption is actually found to exceed 1 liter (about 1 quart) per 1000 km (600 miles), or if
- 2 - the cylinder is not yet out-of-round in excess of 0.02 mm (.0008"). This refers roughly to engines of a mileage below 19,000 (30,000 km).



- a - Top ring
- b - Narrow face contact ring
- c - Oil scraper ring

The installation is useless if

- 1 - it is no definitely known whether an oil leak is involved,
- 2 - the engine has not covered more than 5,000 km (3,000 miles). New pistons often have a higher oil consumption than those already worn in, or if
- 3 - the engine shows excessive wear or has covered considerably more miles than stated.

The installation calls for attention to:

- 1 - the tolerance limits specified for the side clearance and gaps of the rings,
- 2 - proper fit of pistons in cylinders,
- 3 - uniform contact of piston with the cylinder wall (see impression on piston skirt).

Special piston ring sets of other designs should not be used for the following reasons:

- 1 - Substantially higher cost.
- 2 - Shorter service life on account of heavy wear on cylinders and rings (pressure against cylinder wall, matching of materials!).
- 3 - Loss of power by higher frictional resistance.
- 4 - The VW engine does not require breaking-in instructions, even when fitted with narrow face contact rings. Most of the special piston ring sets of other origin call for a careful breaking-in.

5 - First insert the piston pin circlip which faces towards the flywheel.

6 - A certain amount of selective assembly may be necessary when fitting the piston pin. The pin should be a push fit in the piston after the piston has been heated. If the pin can be pushed in with the piston cold, use a larger pin. The correct size is indicated by paint markings in the piston at the piston pin boss and on the piston pin.

Colour	Piston Pins mm $\varnothing$
Black	19.994—19.996
White	19.997—20.000
Green (only pins)	20.001—20.004

The clearance between piston pin and connecting rod bush is 0.005—0.026 mm (0.0002—0.0010"). If the clearance is near the wear limit of 0.05 mm (0.002"), renew the piston pin and the connecting rod bush. No oversize piston should be fitted in this case.

The correct clearance will be indicated by a light finger push fit with the piston pin oiled after the piston has been heated to 80 °C (176 °F) in oil or by the Piston Heating Tool VW 205. Push pin up to the stop of the circlip without pausing.

7 - Insert the other circlip. It is important that the circlips fit in their grooves perfectly.





# Cylinders and Pistons

(From January 1954)

# M

The operations do not differ from those laid down for the 1131 c. c. engine so that in all cases the illustrations and instructions also apply to the 1192 c. c. engine. All dimensions and weights which have been altered in connection with the increased cylinder charge are given below.

## Inspecting Cylinders

An inspection of the cylinders is carried out by means of a dial gauge for inside diameters (cylinder bore indicator) and gauge rings conforming with the cylinder sizes.

Cylinder	Gauge Ring
77.0 mm diam.	VW 252 d
77.5 mm diam.	VW 252 e
78.0 mm diam.	VW 252 f

The fitting clearance between cylinder and piston amounts to 0.036—0.055 mm (0.0014'' — 0.0022'')

Wear Limit:

Clearance cylinder/piston	max. 0.20 mm (0.008'')
Cylinder out-of-round	max. 0.01 mm (0.0004'')

When installing the cylinders, the piston rings are compressed by means of the tool VW 123 a.

### Dimensions and Grading Marks of Cylinders

	Colour	Cylinder mm dia	Corresponding Piston mm dia
Standard Size	Blue	76.990—76.999	76.95
Nominal Dimension 77 mm dia	Pink	77.000—77.009	76.96
	Green	77.010—77.020	76.97
1st Oversize	Blue	77.490—77.499	77.45
Nominal Dimension 77.5 mm dia	Pink	77.500—77.509	77.46
	Green	77.510—77.520	77.47
2nd Oversize	Blue	77.990—77.999	77.95
Nominal Dimension 78 mm dia	Pink	78.000—78.009	77.96
	Green	78.010—78.020	77.97

## Dimensions, Weights, and Grade Marking of Pistons

Size Grading			
	Blue	Paint Dot Pink	Green
Standard Size 77.0 mm $\varnothing$	76.95 mm	76.96 mm	76.97 mm
1st Oversize 77.5 mm $\varnothing$	77.45 mm	77.46 mm	77.47 mm
2nd Oversize 78.0 mm $\varnothing$	77.95 mm	77.96 mm	77.97 mm

Weight Grading	
Paint Line	Weight
Brown (—Weight)	265—270 grammes
Grey (+Weight)	270—275 grammes

The fitting clearance between piston and cylinder is 0.036—0.055 mm (0.0014—0.0022"). If, on measuring the piston and the corresponding cylinder, it is found that the clearance is near the amount of 0.20 mm (0.008"), replace piston and cylinder by another pair of the same size and weight grading. The piston must not be fitted separately, if the corresponding cylinder shows signs of wear. If the corresponding cylinder of a damaged piston does not show any signs of wear, it is often sufficient to fit a new piston of the same size and weight grading. Heat the piston to 80 °C (176 °F) with Electric Piston Heating Tool VW 205 prior to removal or installation.

### Piston rings

Width of compression rings 2.5 mm (0.098")  
 Width of oil ring 4.0 mm (0.16")

Gap clearance of all three rings: 0.30—0.45 mm (0.012"—0.018"); max. 0.95 mm (0.037"). Check ring side clearance in grooves:

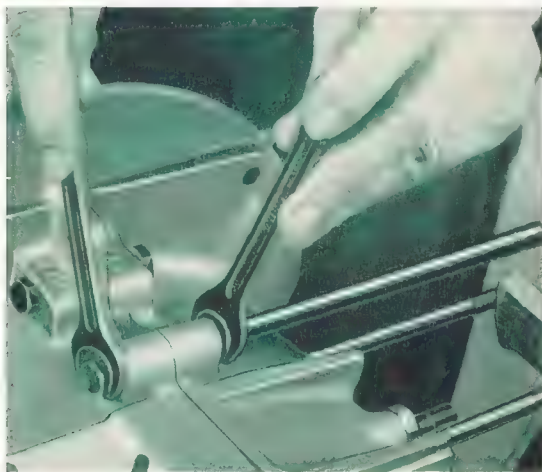
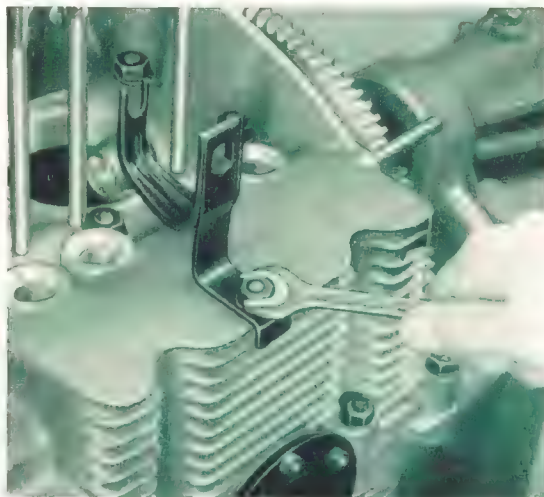
Compression rings 0.035—0.062 mm (0.0014"—0.0024")  
 max. 0.1 mm (0.004")

Oil ring 0.025—0.052 mm (0.001"—0.002")  
 max. 0.1 mm (0.004")

## Disassembling and Assembling Crankcase

### Disassembly

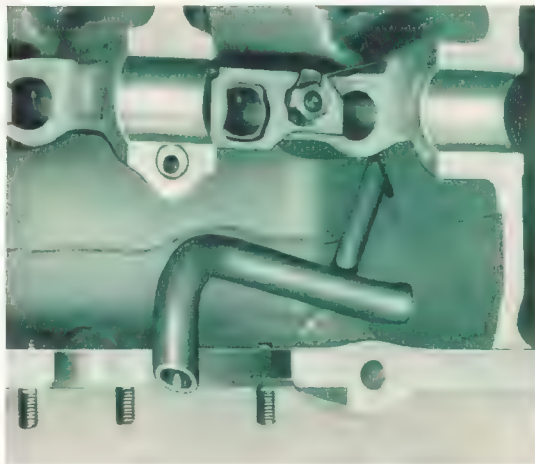
- 1 - Remove oil strainer.
- 2 - Remove oil pressure switch.
- 3 - Remove oil pressure relief valve.
- 4 - Remove crankcase nuts.
  - 3 nuts M 6,
  - 9 nuts M 8,
  - 6 nuts M 10.
- 5 - Remove the throttle ring shaft of the automatic cooling air control.



### Assembly

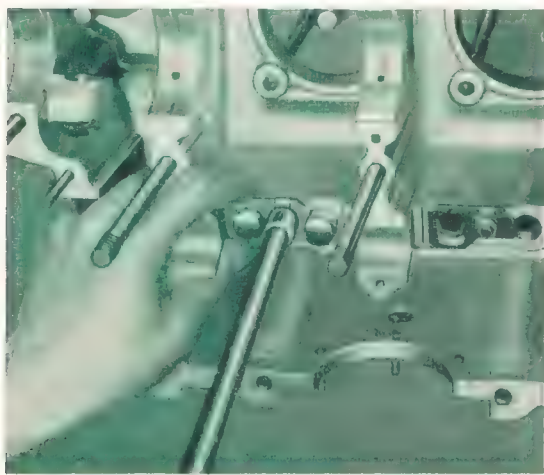
Reassembly of crankcase takes place in the reverse order to the instructions on disassembly, but the following points should be watched closely:

- 1 - Examine crankcase for damage and cracks.
- 2 - Remove all traces of the old sealing compound from the jointing faces, using a solvent. The jointing faces must be dead even and free of burring. The edges at the main bearing points should, if necessary, be slightly chamfered to obtain an accurate matching of the crankcase halves. The oil passages should be flushed and cleaned out by the use of a compressed air line.
- 3 - Check oil suction pipe for secure seating and leaks.
- 6 - Take off right crankcase half, using a rubber mallet to loosen it. Do **not** insert tools or levers between the jointing faces.
- 7 - Take off camshaft and crankshaft.
- 8 - Remove camshaft end plug.
- 9 - Remove crankshaft oil seal.
- 10 - Remove gasket on generator support.
- 11 - Remove valve push rod guide plates.
- 12 - Remove support for thermostat of the automatic cooling air control.



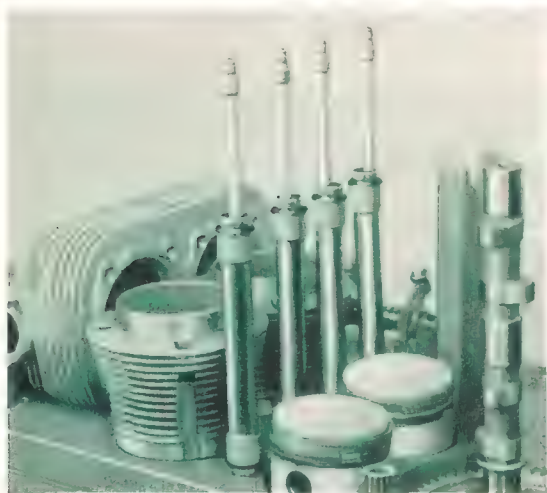


4 - Adjust valve push rod guide plates. The push rods should, in oiled condition, glide in the guide holes by their own weight and no marked clearance must be felt when attempting to rotate the push rods back and forth. Permissible clearance: 0.01—0.02 mm (0.0004—0.0008"). Care must be taken not to turn the guide plates out of place when tightening, as the push rod ends will otherwise not bear squarely on the cams. Noisy operation and increased wear would be the result.



If the push rods produce a noise due to excessive lateral clearance, replace them by oversize push rods.

5 - It is advisable to mark or handle the push rods in a way which will assure proper installation when assembling the engine.



6 - Check and install oil pressure relief valve.

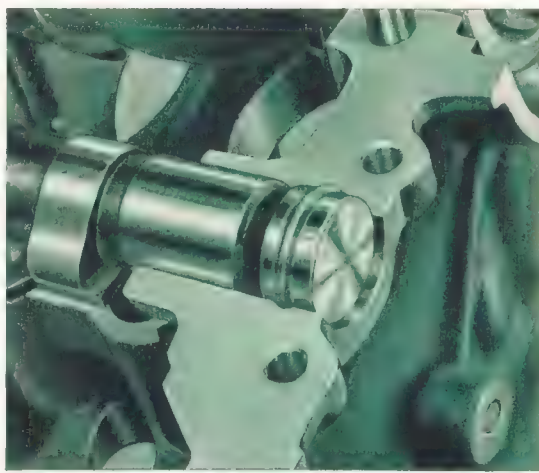
7 - Check and install oil pressure switch.

8 - Note position of timing marks on timing gears and make sure the crankshaft oil thrower is correctly installed.

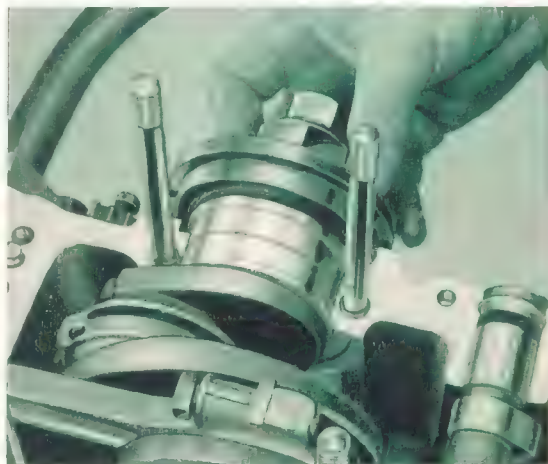
9 - Install crankshaft and bearings after having oiled the bearing points.

10 - Install camshaft.

11 - Install camshaft end plug, thrust washer, and



crankshaft oil seal by means of the Tool VW 204. Use sealing compound.



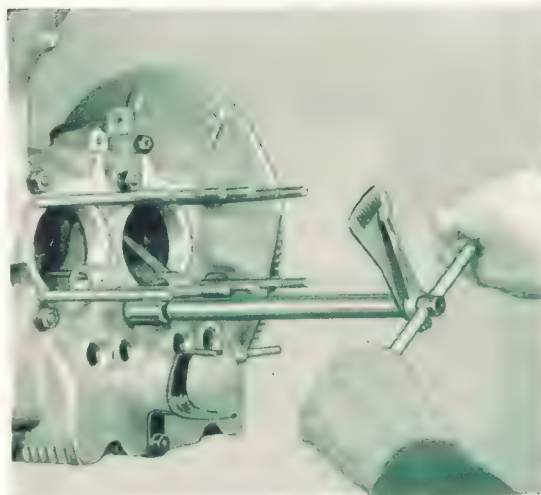
The oil seal must rest squarely on the bottom of its recess in the crankcase.

12 - Evenly spread a thin film of sealing compound on the crankcase jointing faces. On no account must the sealing compound enter the oil return passages of crankshaft and camshaft bearings.

- 13 - Join the crankcase halves and evenly tighten the nuts with a torque wrench as follows:

Metric Thread	Torque
6 Nuts M 10	3 mkg (22 ft. lbs.),
10 Nuts M 8	2 mkg (15 ft. lbs.).

Then proceed to tighten the 3 nuts M 6.



## Oversize Crankcase Studs

The tapped stud holes in the crankcase may become damaged due to overstraining, or some other reason, leading in some cases to oil leaks.

It is then permissible to re-tap the holes 2 mm oversize. To ensure a correct sealing, the thread should be cut, however, to the following unorthodox dimensions:

Female Thread in Crankcase			
Nominal Diameter	Major Diameter (mm)	Pitch Diameter (mm)	Minor Diameter (mm)
M 8	7.630— 7.705	7.188— 7.300	6.416— 6.731
M 10	9.616— 9.698	9.026— 9.138	8.097— 8.452
M 12 x 1,5	11.616—11.698	11.026—11.138	10.097—10.452

The following drills must be used for boring up the holes:

- 6.7 mm drill for thread M 8
- 8.4 mm drill for thread M 10
- 10.5 mm drill for thread M 12 x 1.5

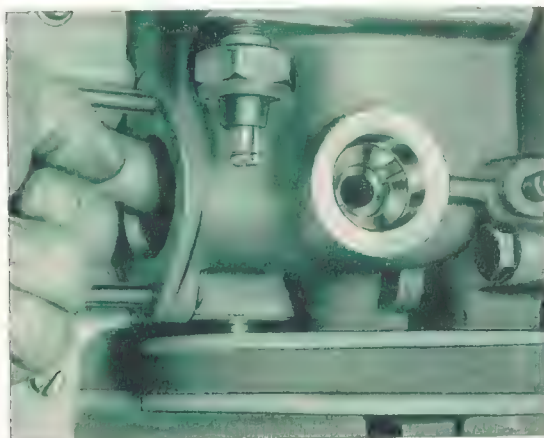
The threads are cut by single thread machine taps (DIN 376), the major diameters of which should be ground down to the following dimensions (VW Works Norm ZN 7038):

Taps			
Nominal Size	Major Diameter		
	Lower Limit (mm)	Upper Limit (mm)	Permissible Wear up to (mm)
M 8	7.660	7.680	7.630
M 10	9.640	9.660	9.616
M 12 x 1.5	11.640	11.660	11.616

## Removing and Installing Distributor Drive Pinion

### Removal

- 1 - Disconnect cable No. 1 from distributor.
- 2 - Remove distributor cap.
- 3 - Release distributor retainer clamping bolt.
- 4 - Lift off distributor.
- 5 - Remove fuel pump and intermediate flange, gaskets, and fuel pump push rod.
- 6 - Remove coil spring on distributor drive pinion.
- 7 - Grip distributor drive pinion through the opening of the fuel pump jointing flange and lift it up while turning it anti-clockwise.



- 8 - Take out washer under distributor drive pinion. (Do not let it drop into the timing gear chamber!)



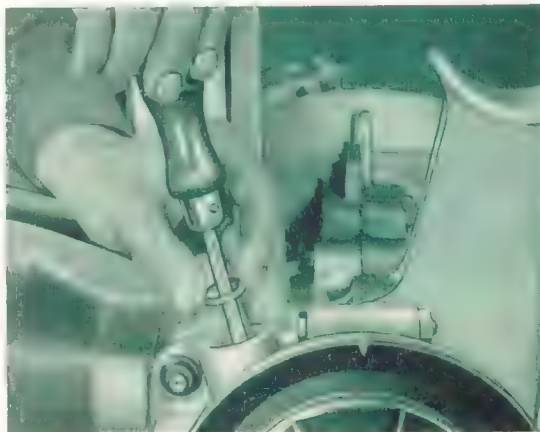
1 - Distance spring  
3 - Washer

2 - Distributor drive pinion.

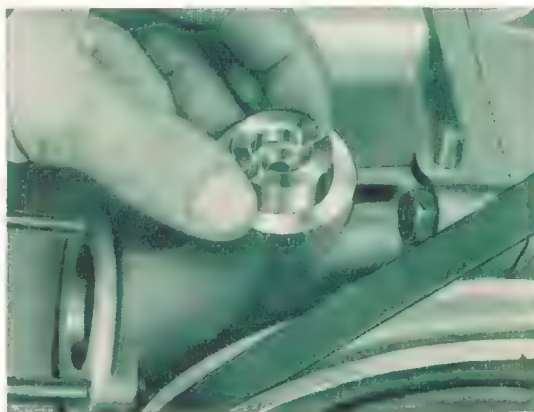
### Installation

Installation is a reversal of the removal procedure. The following points should be observed:

- 1 - Check eccentric and spiral gear for wear. Replace distributor drive pinion if found necessary. In the case of a badly worn spiral gear, examine also the teeth of distributor drive gear.
- 2 - Inspect washer under distributor drive pinion for wear. Renew if necessary. (Do not let the washer drop into timing gear chamber when installing!)



- 3 - Reinstall distributor drive pinion after cylinder No. 1 has been set to firing position (note timing mark on fan pulley). With the pinion in the proper position, the slot in the top must be approximately parallel to the fan pulley. The narrow side of the top is towards the pulley.



- 4 - Reinstall distance spring.
- 5 - Set ignition.

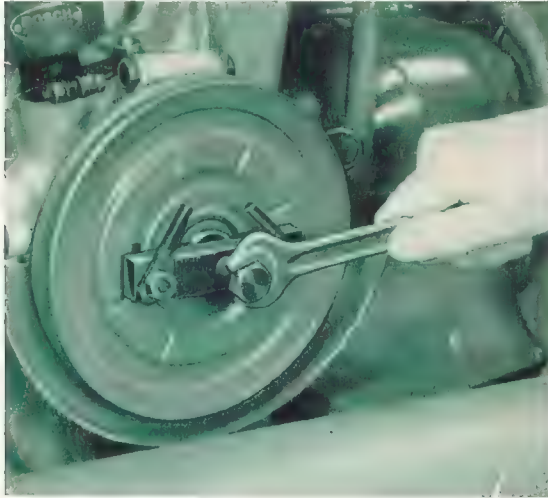


## Removing and Installing Crankshaft Fan Pulley

(with engine in situ)

### Removal

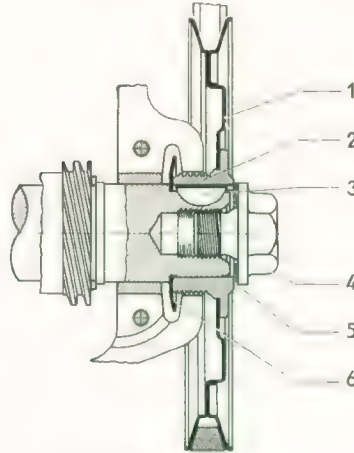
- 1 - Take off fan belt.
- 2 - Remove engine rear cover plate.
- 3 - Unscrew pulley mounting bolt.
- 4 - Extract pulley using tool VW 203 b.



### Installation

This is a reversal of the above operations, but it is important to observe the following points:

- 1 - Carefully inspect pulley for damage prior to installation. Clean oil return thread.
- 2 - Make sure the pulley is running true.
- 3 - In the case of oil leaks, use a pulley with bigger oil return thread (oversize).



- 1 - Crankshaft pulley
- 2 - Oil return thread
- 3 - Woodruff key
- 4 - Mounting bolt
- 5 - Spring washer
- 6 - Crankshaft oil thrower

## Removing and Installing Flywheel

### General Description

The flywheel is attached to the crankshaft by means of a gland nut and dowel-located by 4 dowels. A paper gasket is fitted between flywheel and crankshaft. Oil sealing is done by an oil seal recessed in the crankcase casting at main bearing No. 1. The oil seal lip fits over the flywheel jointing flange. A bush, supporting the main drive shaft pilot, is situated in the gland nut.

### Removal

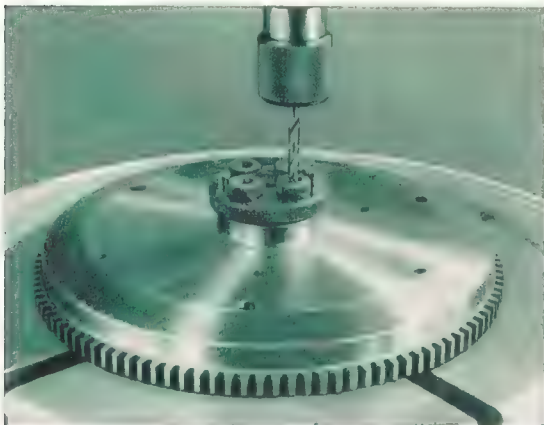
- 1 - Remove clutch pressure plate.
- 2 - Remove clutch driven plate.
- 3 - Unscrew gland nut, using 36 mm Special Wrench VW 112. Remove guide plate of the special wrench.
- 4 - Withdraw flywheel.



## Installation

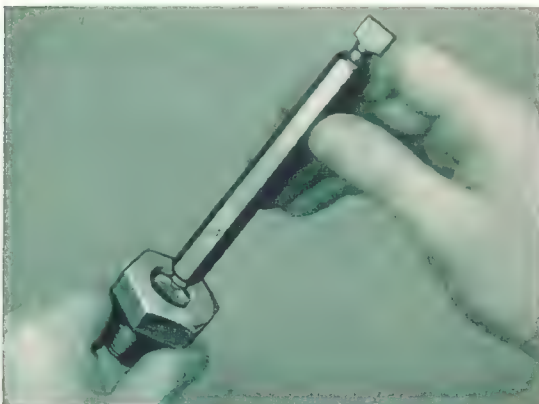
Installing the flywheel is a reversal of the above, but the following points should be noted:

- 1 - Check flywheel teeth for wear and damage. Lightly damaged gear rings may be remachined, removing 2 mm (0.08'') metal at the clutch side of the gear ring. Re chamfer the teeth to assure a proper engagement with the starting motor pinion.
- 2 - Check dowel holes in flywheel. If they are worn, place Drill Jig VW 231 b on flywheel, drill new holes of 5.8 mm  $\varnothing$  (0.228'') 45° away from the



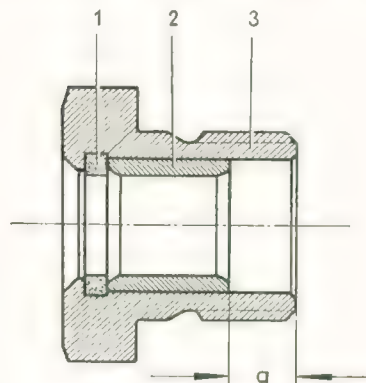
original holes, and ream them to 6 mm (0.236''). Plug up one of the old holes to avoid confusion.

- 3 - Inspect dowel holes in crankshaft for wear. If they are worn, remove crankshaft, drill new holes of 5.8 mm  $\varnothing$  (0.228'') 45° away from the original holes, and ream them to 6 mm (0.236'').
- 4 - Renew dowels if these are worn.
- 5 - Adjust crankshaft end play.
- 6 - Check pilot bush in gland nut for wear, using Plug Gauge VW 246.



If excessively worn, renew the pilot bush and the gasket, using Pilot Drift VW 218.

Seating depth of bush:  $a = 10$  mm (.39'').

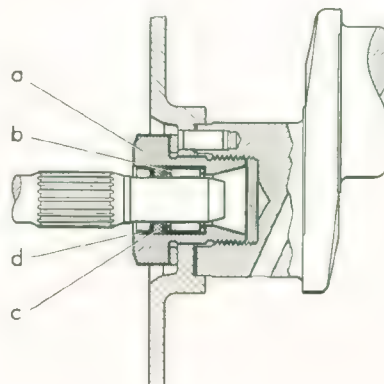


- 1 - Gasket
- 2 - Bush
- 3 - Gland nut

Fill the bush with about 10 grammes (.35 oz.) of Universal Grease VW — A 052.

## Note:

From Chassis No. 1—0929746 onwards, a needle bearing has been used in the gland nut. The needle bearing is also lubricated with about 10 g (0.35 oz.) Universal Grease VW — A 052; the larger amount should be used to fill the needle cage.



- a - Gland nut
- b - Needle bearing
- c - Oil seal
- d - End ring

The needle bearing cannot be used in earlier type gland nuts. That is why the bronze bush is still obtainable as a spare part.

7 - In order to counteract the existing permissible unbalance of crankshaft, flywheel, and clutch, the heaviest points of these parts are marked. In assembly, it should be made sure that these marks are 120 deg. apart. If only two of the three parts are marked, the marks should be 180 deg. apart.

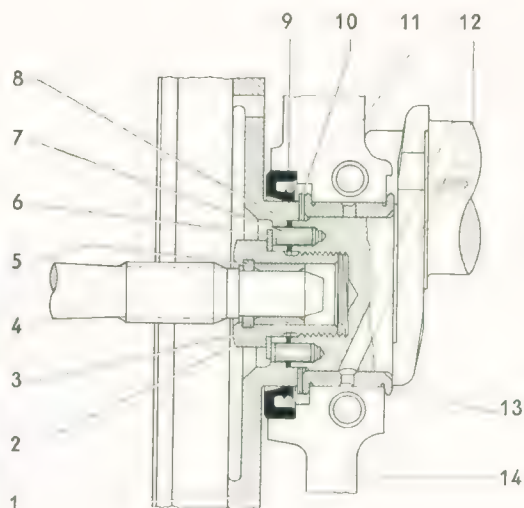
Parts	Mark
Crankshaft	Paint dot in crankshaft tapped hole which accepts flywheel gland nut.
Flywheel	Paint dot and 5 mm dia. (0.2") hole on the face which is towards the clutch.
Clutch	Paint line at the outer edge of the clutch cover.



8 - Tighten gland nut to 30 mkg (217 ft. lbs.), using a torque wrench in conjunction with VW 163a and the guide plate of the tool VW112.

9 - Check flywheel for true running:

Lateral run-out-max. 0.3 mm (0.012").  
Radial run-out max. 0.4 mm (0.016").



- 1 - Flywheel
- 2 - Gland nut
- 3 - Pilot bush
- 4 - Main drive shaft
- 5 - Gasket
- 6 - Lockwasher
- 7 - Dowel pin
- 8 - Gasket
- 9 - Oil seal
- 10 - Shims
- 11 - Crankcase
- 12 - Crankshaft
- 13 - Crankshaft bearing
- 14 - Crankcase

## Removing and Installing Crankshaft Oil Seal

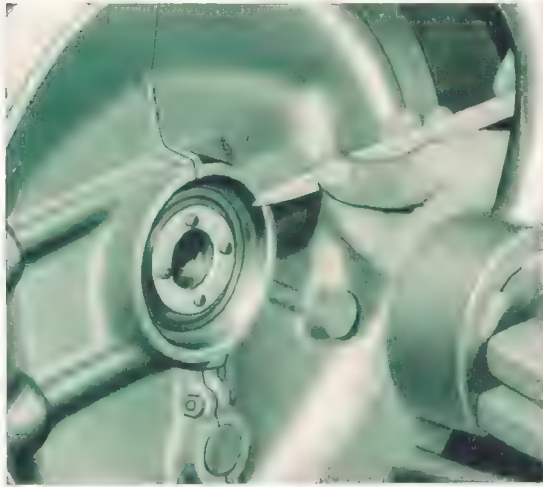
(with engine assembled)

- 1 - Remove flywheel. Inspect oil seal lip contact surface on flywheel jointing flange.
- 2 - Remove old oil seal.

- 3 - Clean oil seal recess in crankcase and coat it with a thin film of sealing compound. Should it become necessary, slightly chamfer the outer

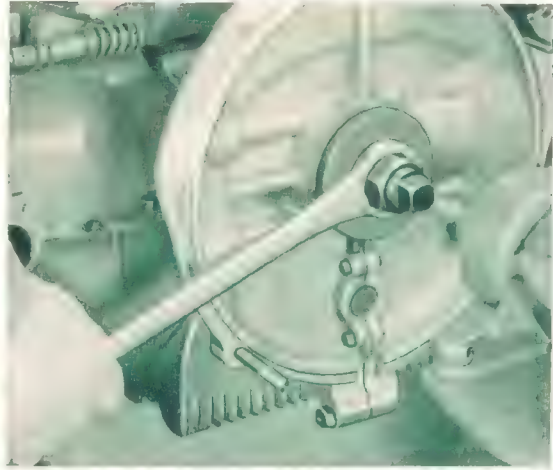


edge by means of a scraper. Clean the recess from metal chips.



4 - Install new oil seal using Tool VW 204. Screw the tool into crankshaft and insert oil seal by

tightening the guide piece. The oil seal must be squared on the bottom of its recess.



5 - Remove the tool.

6 - Reinstall flywheel. The oil seal lip contact surface is to be lubricated with oil.

## Removing and Installing Camshaft

### Removal

- 1 - Open the crankcase.
- 2 - Lift off camshaft.

for wear. The cam faces must not be scored and must be perfectly smooth and square.

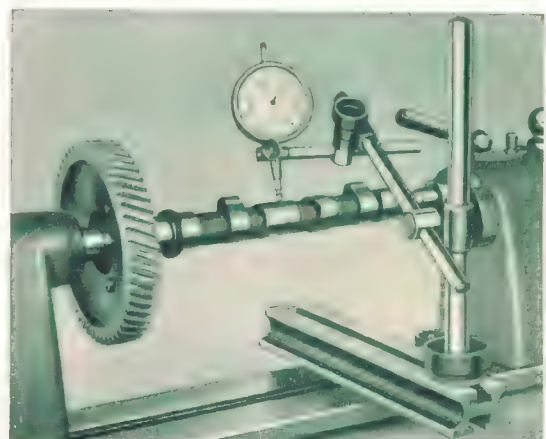
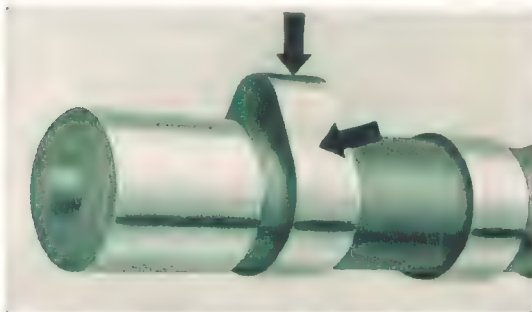
See "List of Tolerances and Wear Limits" for permissible end play.

### Installation

This is a reversal of the above, but it is important to observe the following points:

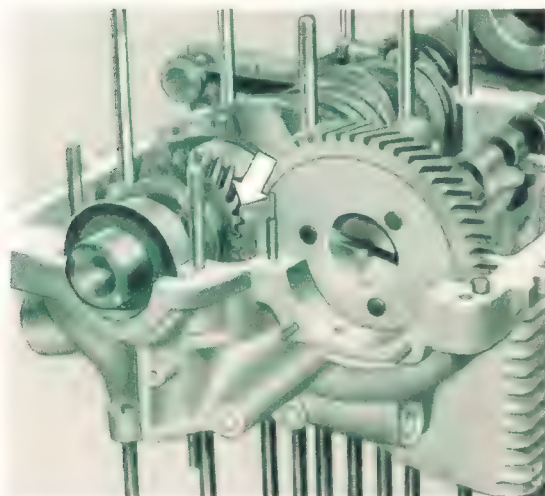
- 1 - Examine riveted joint between camshaft timing gear and camshaft.
- 2 - Check camshaft bearing points and cam faces

- 3 - Check camshaft for run-out.



4 - Examine camshaft timing gear for wear and correct tooth contact.

5 - When installing camshaft, take care that the timing gear tooth marked "0" is situated between the two teeth of the crankshaft timing gear marked with a prick punch.



6 - Check backlash of camshaft timing gear (0.010—0.035 mm/.0004"—.0014").

#### Note:

From Chassis No. 1033950 with initial exceptions and from Chassis No. 1266671 all current production camshafts are equipped with timing gears of light metal alloy.

Following the introduction of the new timing gears, the backlash tolerance has been increased from 0.0—0.025 mm (.001") to 0.0—0.052 mm (.002"). When installing camshafts with light metal alloy gears, the lower backlash tolerance limit should be approached. To obtain the correct backlash, camshafts are available with plus or minus deviations of the timing gears:

Part No. 111109027 = + 3	111109019 = - 1
111109025 = + 2	111109017 = - 2
111109023 = + 1	111109015 = - 3
111109021 = 0	

To obtain a silent and smooth running of the timing gears, the specified backlash should be strictly adhered to. A check is carried out by rocking the gears back and forth with both hands, while gradually revolving the camshaft timing gear, until it has made a complete turn. The teeth of the camshaft timing gears used on the Deluxe are of fiber.

To assist in obtaining the specified backlash, the camshaft are available with timing gears in five sizes under different part numbers.

The timing gears are marked 0, +1, +2, —1 and —2, etched on their inner face. The digits indicate in  $\frac{1}{100}$  mm how much the pitch radius departs from the standard pitch radius denoted by "0". The oversizes are marked "+1" or "+2", while undersizes can be identified by "—1" or "—2".

**Caution.** — The mark "0" on the outer face of each camshaft timing gear is to insure correct installation of the camshaft in relation to the crankshaft timing gear and has nothing to do with the aforementioned size markings.

The crankshaft timing gear is obtainable in one size only.

#### Note:

The following points should be observed whenever installing a camshaft:

- a - Check bearing journals, cams, and timing gear for damage. Slight damage may be smoothed down with an oilstone (silicon carbide) — a 100—120 grain stone should be used before polishing with a 280—320 grain stone.
- b - Remove any burr from the cam edges, using an oilstone of the grain mentioned under a —. Carefully clean camshaft from abrasive particles.

#### Important!

No attempt should be made to remove burr by grinding, as such practice would excessively reduce the cam width.

- c - Prior to installation, apply a few drops of engine oil to bearing journals and cams.

## Removing and Installing Crankshaft and Connecting Rods

### Removal

- 1 - Open the crankcase.
- 2 - Take off camshaft.
- 3 - Remove crankshaft and connecting rods as a unit.
- 4 - Take off crankshaft oil thrower and main bearings 1 and 4.

### Note:

Removed crankshaft must not be stored without having applied a rust preventive to their surface, as oil, grease, etc.

### Installation

This is a reversal of the above procedure. The following points should be noted:

- 1 - The crankshaft bore in the crankcase must have no sharp edges at the jointing faces. Slightly chamfer the edges.
- 2 - Check dowels for tightness.
- 3 - The oil passages in the crankshaft must have no sharp edges. Should foreign matter be embedded in the main bearings, it may be removed by means of a scraper which must be free from burr. Care must be exercised not to remove metal from the bearing shell itself.
- 4 - Place one half of main bearing No. 2 in crankcase.

### Note:

From Chassis No. 1381245 the thickness of the main bearing wall has been increased by 0.02 mm (.0008") at the points subjected to the highest pressure, i.e., midway between the jointing faces of each bearing half. When the crankcase nuts are tightened to the specified torque, the ovalness of the bearing is removed by virtue of the pressure imposed on it by the crankcase. The modified bearing (Part No. 111105531 A) can be installed in all engines previously manufactured.

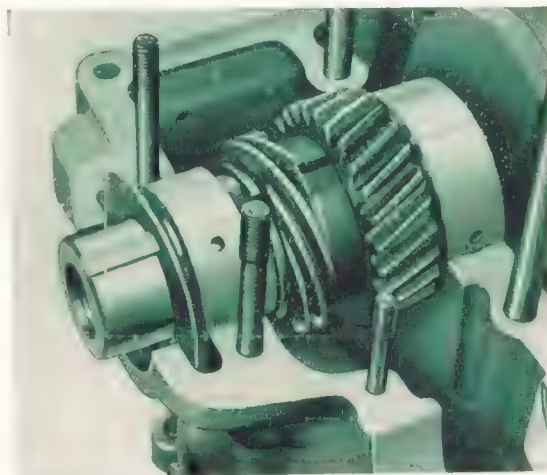
The reinforced bearing will soon be available in undersizes under the following part numbers:

- 0.25 mm undersize — Part number 111105537 A
- 0.50 mm undersize — Part number 111105543 A
- 0.75 mm undersize — Part number 111105549 A
- 1.00 mm undersize — Part number 111105555 A

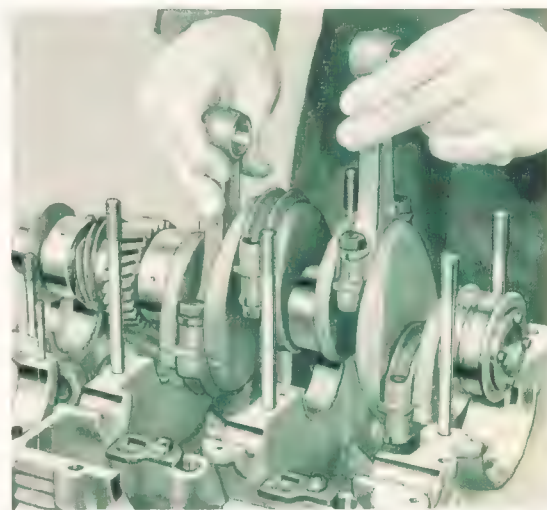
The modified bearing offers less friction to the crankshaft journal.

- 5 - Place main bearing No. 1 on crankshaft, taking care that the dowel hole is offset towards the flywheel.

- 6 - Install crankshaft oil thrower, the concave surface of which must face the pulley side of the crankcase.



- 7 - Reinstall crankshaft. Starting at main bearing No. 1, make sure that all bearings are properly dowel-located.



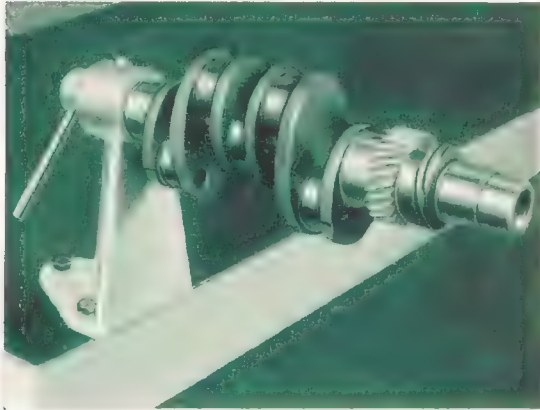
- 8 - Note marks on timing gears when installing camshaft.



# Removing and Installing Connecting Rods

## Removal

- 1 - Remove crankshaft and attach it to the Holding Fixture VW 310.



- 2 - Unscrew connecting rod bolts and remove connecting rods and caps.

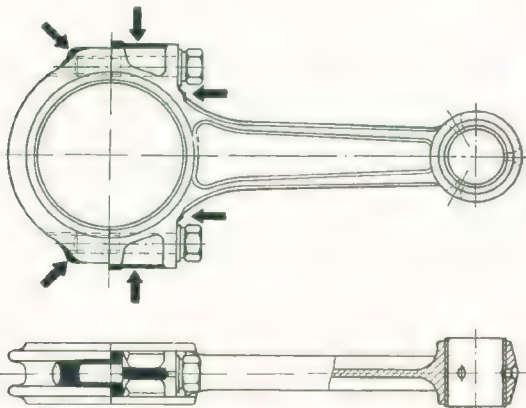
## Installation

This is a reversal of the above, but the following points should be observed.

- 1 - Check weight of connecting rods. The difference in the weight of the connecting rods in one engine must not be in excess of 11 g (0.39 oz.) to maintain proper engine balance.

### Note:

When dealing with 1192 c.c. engines, a difference of 5 g (.18 oz.) in the weight of the connecting rods in one engine should not be exceeded. If necessary, metal should be removed from the overweight connecting rods at the points indicated below. In following this method, the weight of one connecting rod may be reduced by about 6 g (.21 oz.).



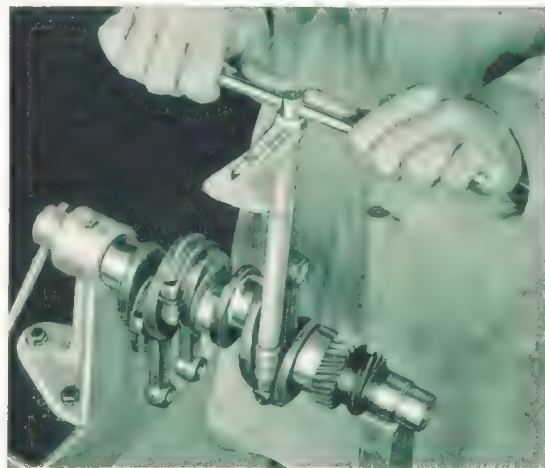
- 2 - Inspect piston pin bearing for damage and wear. With a new bearing, the correct clearance is indicated by a light finger push fit of the pin at room temperature.

- 3 - Check and, if necessary, correct connecting rod alignment.

- 4 - Reinsert connecting rod bearing shells after all parts have been thoroughly cleaned and assemble connecting rods on crankshaft. The identification numbers stamped on connecting rods and bearing caps must both be on one side.



- 5 - Tighten connecting rod bolts to a torque of



5 mkg = 36 ft. lbs., using a torque wrench with a 14 mm socket. A slight pretension between the bearing halves, which is likely to occur when tightening the connecting rod bolts, can be eliminated by light hammer taps. The connecting rods, lubricated with motor oil

prior to assembly, must slide on the crank pin by their own weight. No scraping, reaming, or filing is permissible in the assembly of the connecting rod bearings.

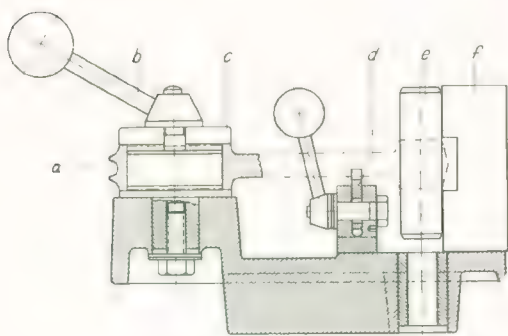
- 6 - Secure connecting rod bolts in place, using chisel VW 124.



## Reconditioning Connecting Rods

In the case of excessively worn piston pin bearings, renew the bearings and check connecting rods for alignment.

- 1 - Remove piston pin bearing, using tool VW 212 a.
- 2 - Place connecting rod in the Device VW 214.
- 3 - Place the C-washer (c) in position and tighten the lever (b) to such an extent as to still allow the connecting rod to have sufficient play to be moved one way or the other. The support (d) is released.

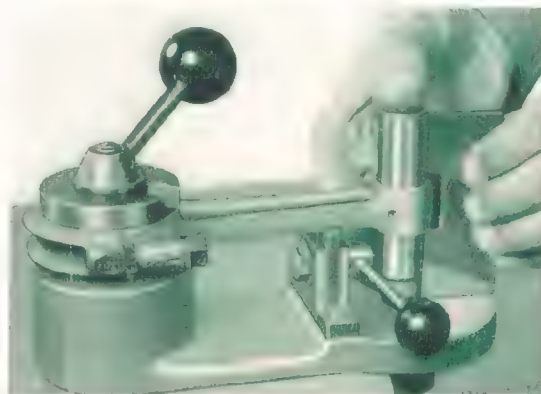


**Device VW 214**

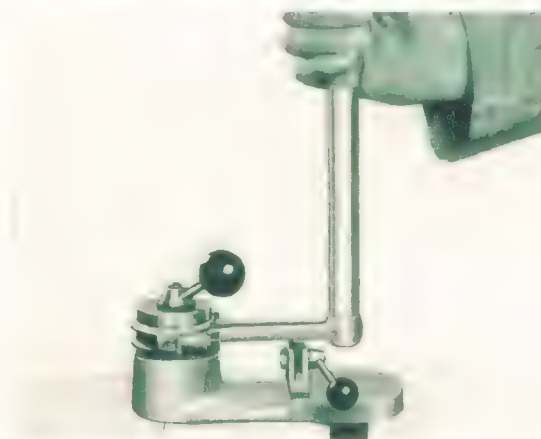
- |                   |             |
|-------------------|-------------|
| a - Mandrel       | d - Support |
| b - Locking lever | e - Pin     |
| c - C-washer      | f - Gauge   |

- 4 - Then insert pin (e) in little end bore pressing it with two fingers towards the mandrel (a) so that there is no tilt between mandrel (a) and connecting rod bearing nor between little end bore and pin.

- 5 - Check connecting rod for twist and parallelism by means of the gauge (f).

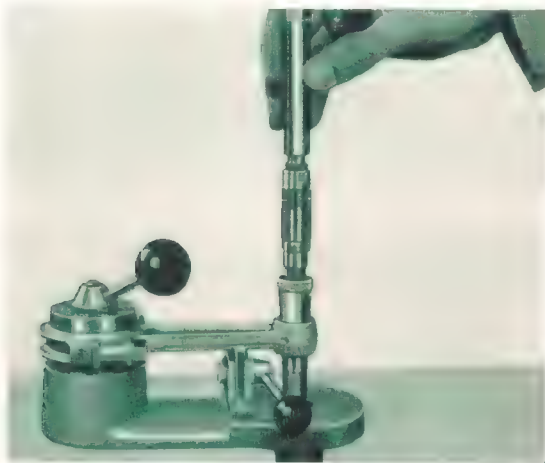


If correction is necessary, fully tighten locking lever (b) and straighten connecting rod by means of the bar.



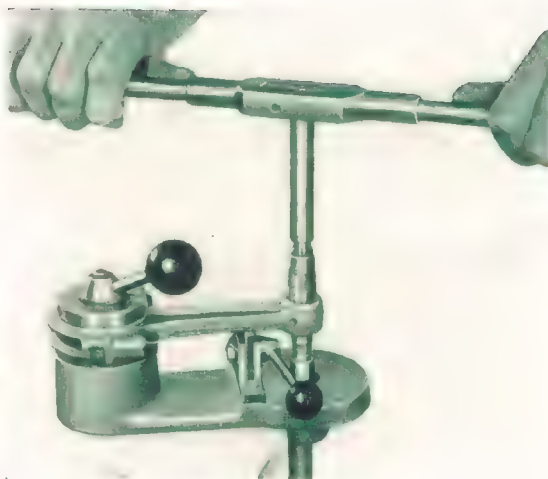
6 - The new bearing must be pressed in centrally so that it evenly projects on both sides. Drill oil passages.

7 - Insert reamer in piston pin bearing and the hole in the bottom plate of the device, the guide bush ensuring a correct centring of the piston pin bearing. Tighten locking lever (b) and support (d).



8 - Ream up piston pin bearing. Inner diameter: 20.005—20.02 mm (0.7876—0.7881").

The bearing bore must be free from scores and chatter marks after reaming. Without applying oil, the piston pin must be a light finger push fit in the bearing.



The piston pin must be fitted at room temperature. It is wrong practice to fit an oversize piston pin in order to eliminate undue clearance between piston and bearing. A new bush must in all cases be installed and reamed to size.

9 - Recheck connecting rod for parallelism and twist as mentioned previously, but this time with the piston pin in lieu of the pin of the device. Correct, if necessary, with a bar inserted in the piston pin.

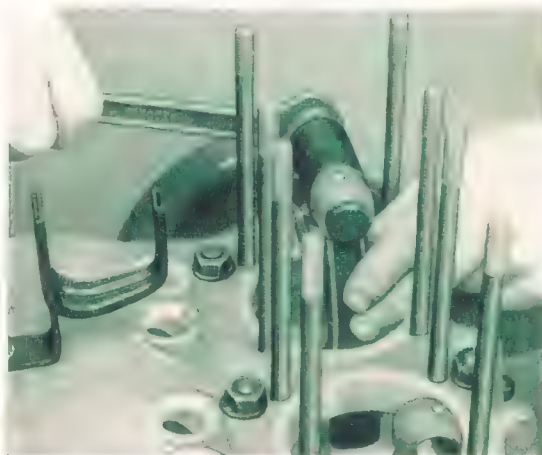
## Renewing Piston Pin Bearing

(with crankshaft installed)

Piston pin bearings can also be renewed with the crankshaft in place, after cylinders and pistons have been removed.

### Removal and Installation

Driving out and pressing in of piston pin bearing is effected by means of the Tool VW 212 a.

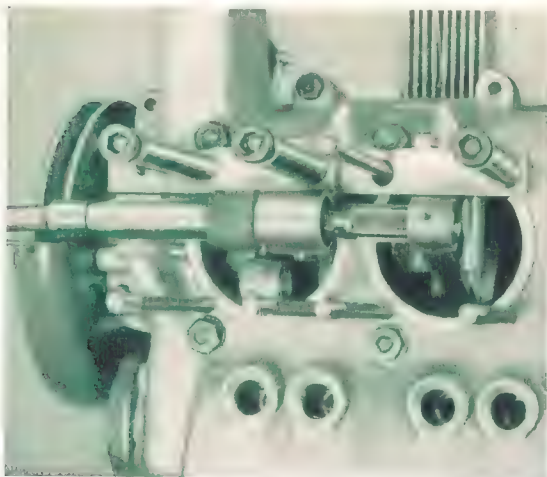




### Reaming to Size

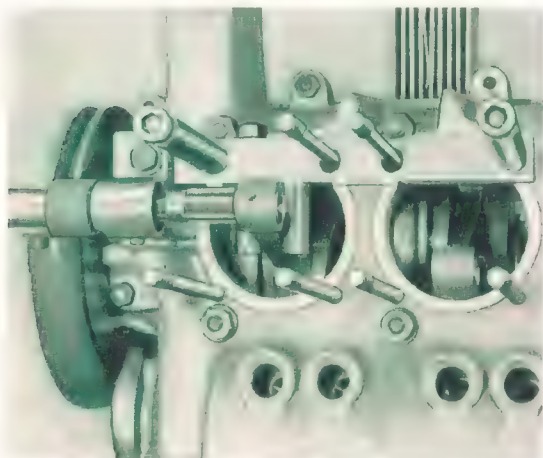
The Tool VW 260 has been designed for reaming piston pin bearings with the crankshaft in place.

Arrangement of reaming tool on cylinder No. 1 (same as on cylinder 3):



- a - Place the straight edge in position, taking care that the two stop pins rest against the cylinder seat when tightening.
- b - The two eccenters in the straight edge must hold the connecting rod so that there is no play in the reaming direction. The connecting rod is centered by the tapered guide pin at the reamer shaft.
- c - Insert reamer and ream bush to size. The two eccenters take up the pressure when reaming.

Arrangement of reaming tool on cylinder No. 2 (same on cylinder No. 4):



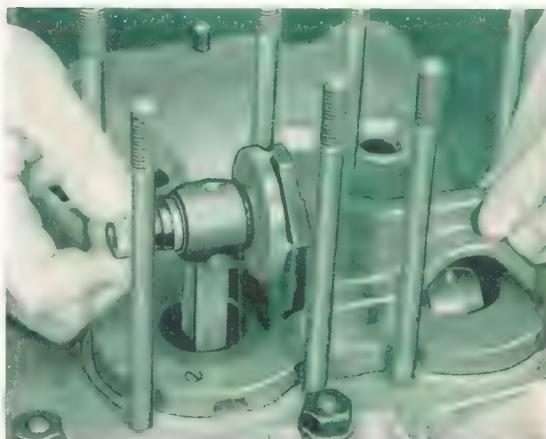
### Connecting Rod Alignment

After reaming, the connecting rod must be checked for alignment, using Gauge VW 250.

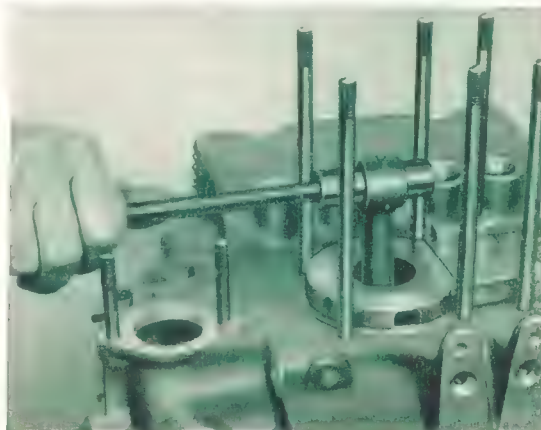
#### Note:

The Gauge VW 250 is only suitable for 1131 cc. engines.

- a - Place base plate on the cylinder seats on one side of the crankcase so that the annular guide is situated at the connecting rod to be checked.
- b - Rotate crankshaft until connecting rod has reached top dead center position.
- c - Insert test plate into piston pin bearing and tighten at the knurled-head screw.
- d - The angular piece on the base plate is then to be moved along the guide bar against the test plate. Check connecting rod for twist and bends.



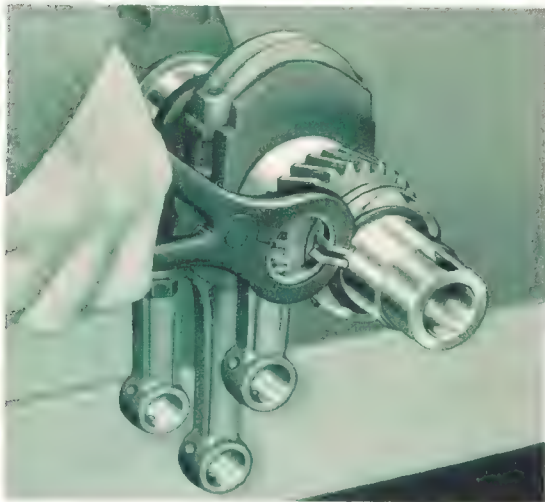
- e - Should it become necessary, rectify connecting rod alignment by fitting a piston pin and straightening by means of a bar inserted in the piston pin as shown in the photo below.



# Disassembling and Assembling Crankshaft

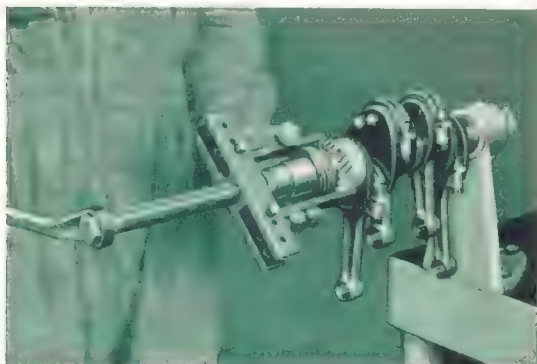
## Disassembly

- 1 - Attach crankshaft to Holding Fixture VW 310.
- 2 - Remove distributor drive gear retaining ring, using Tool VW 161 a.



- 3 - Remove distributor drive gear, spacer, and crankshaft timing gear, using Extractor VW 202 in conjunction with VW 202 a and VW 202 f.

Heat the gears in oil to approx. 80 °C (176 °F) before removing them to avoid damage to the seating surface. Light signs of seizure can be removed, provided that the press fit will not be affected.



- 4 - Remove main bearing No. 3.
- 5 - Remove connecting rods.

## Important!

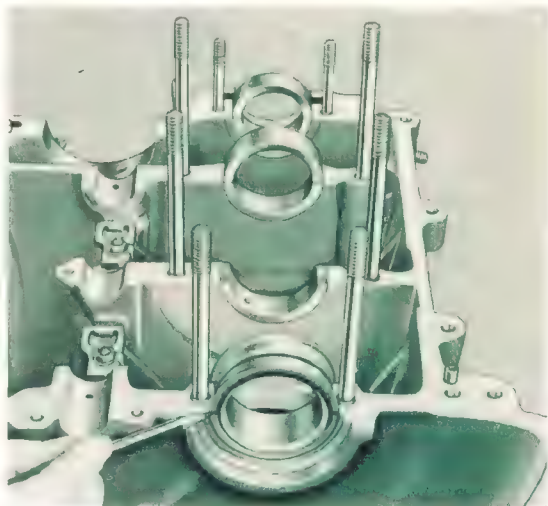
Do not store crankshafts without applying a rust preventive to their surface, as oil, grease, etc.

## Assembly

This is a reversal of the preceding operations, but the following points should be observed:

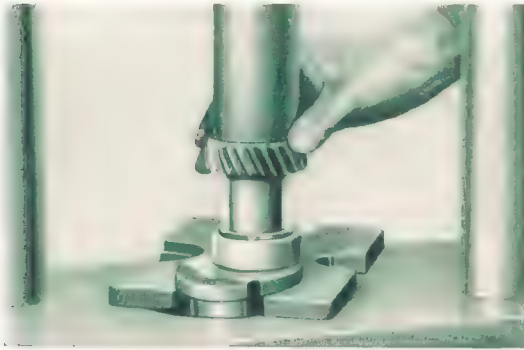
- 1 - Check crankshaft for run-out, cracks ("ringing" test), and wear. Should it become necessary, regrind or renew crankshaft and install new main bearings. To assure a correct assembly, first place main bearings 1, 3, and 4 in left-hand half of crankcase, noting proper position of dowel holes and oil holes which must register with the oil passages in the crankcase. The dowel hole in main bearing 1 must be towards the flywheel.

To facilitate fitting of main bearings on the dowels when installing crankshaft, it is recommended to mark the bearings at the crankcase jointing face level with a pencil.

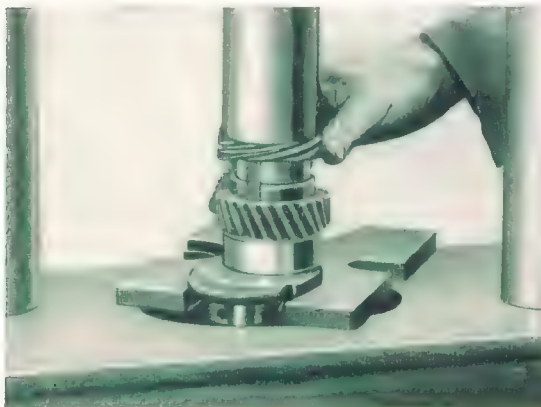


- 2 - Check dowel holes in crankshaft face for wear. If they are worn, remove crankshaft, drill new holes of 5.8 mm  $\varnothing$  (0.228") 45° away from the original holes (use drill jig 231 a), and ream them to 6 mm (0.236").
- 3 - Slide main bearing No. 3 in position and insert Woodruff key for crankshaft timing gear and distributor drive gear.

- 4 - Check crankshaft timing gear for wear and check tooth contact. Heat the gear to about 80 °C (176 °F) in an oil bath and press it in position using Guide Tube VW 427. Slide spacer on crankshaft.



- 5 - Check distributor drive gear for wear. Heat the gear to about 80 °C (176 °F) and press it in position, using Guide Tube VW 427.



- 6 - Install retaining ring, using Tapered Guide Tube VW 284 to avoid damage to the crankshaft journal. Check gears for secure seating after they have cooled down.



- 7 - Clean out oil passages, using compressed air.

- 8 - Assemble connecting rods.



**Important!**

From Chassis No. 1299842 the clearance of main bearing 4 on the crankshaft journal has been brought into line with that of the remaining main bearings.

Clearance previously: 0.031—0.083 mm (.0012"—.0033")

now: 0.047—0.102 mm (.0019"—.0040")

Thickness of bearing wall previously: 4.989—4.979 mm (.1884"—.1880")

now: 4.883—4.972 mm (.1882"—.1877")

The object of this measure is to minimize the frictional resistance, thereby promoting the readiness of the engine to start.

**Note:**

The crankshaft/flywheel unit of the 1192 c. c. engine differs from that of the 1131 c. c. engine as detailed below:

**Crankshaft**

1131 c. c. engine	1192 c. c. engine
The hole accepting the flywheel gland nut is chamfered	The hole accepting the flywheel gland nut is chamfered and incorporates a cylindrical portion of about 5 mm (.2") in front of the thread
Part No. 105101 has not been changed	

**Flywheel**

1131 c. c. engine	1192 c. c. engine
Hole inside dia. 28.5/28.0 mm (1.122"/1.102")	Hole inside dia. 29.0/28.6 mm (1.142"/1.126")
Part No. 105171 has not been changed	

**Gland Nut**

1131 c. c. engine	1192 c. c. engine
Length 34.4/34.0 mm (1.354"/1.339") Diameter of shoulder 27.98/27.80 mm (1.102"/1.094")	Length 35.2/34.8 mm (1.386"/1.370") Diameter of shoulder 28.500/28.487 mm (1.1220"/1.1215") The gland nut shoulder fits into the crankshaft hole
Part No. 105205	Part No. 105205 a

**Interchangeability**

The assembly of the crankshaft includes the following four possibilities:

	Engine	Crankshaft		Flywheel		Gland Nut
1	1131 c. c.	old	+	old	+	old
2	1131 c. c.	old	+	new	+	old
3	1131 c. c.	new	+	old	+	old
4	1131 c. c. and 1192 c. c.	new	+	new	+	new

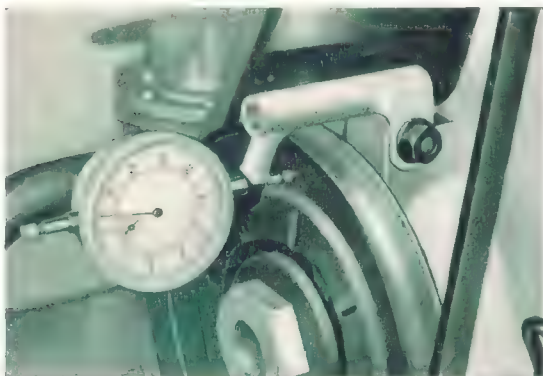
## Crankshaft End Play

### Checking Crankshaft End Play

Crankshaft end play should be within 0.07 mm and 0.12 mm (0.0028" and .0047"), the wear limit being 0.15 mm (.006"). The end play can conveniently be checked with the engine installed or removed. A bracket (local manufacture VW 659) has been designed to hold a dial indicator.

### Engine Installed in Vehicle

The end play reading is taken at the pulley. The dial indicator bracket is mounted on the rearmost crankcase stud that holds intake manifold support. An end play reading is obtained by rocking the crankshaft back and forth at the pulley hub.



### Adjusting End Play

- 1 - Force the installed crankshaft against the flywheel side of the engine (with flywheel, paper gasket, oil seal, and shims removed) to take up the play.
- 2 - Insert Dial Gauge VW 292 in flywheel seat so that it contacts the crankshaft and measure distance from crankshaft face to outer face of main bearing No. 1.



### Engine Removed

The end play reading is taken at the flywheel. The dial indicator is held by one of the engine mounting bolts.



- 3 - Place Gauge VW 292 on flywheel jointing flange and measure depth of crankshaft seat.



4 - The thickness of the shims to be used is decided by the difference in both readings (taking into account the paper gasket). The thickness of the paper gasket is 0.2 mm (0.0078'') and is compressed by 0.05 mm (0.0019'') in assembling, leaving 0.15 mm (0.0059'') to be considered when deciding thickness of shim.

Shims of the following thicknesses are available:

0.30 mm (0.28—0.30 mm)  
 0.32 mm (0.30—0.32 mm)  
 0.34 mm (0.32—0.34 mm)  
 0.36 mm (0.34—0.36 mm)  
 0.38 mm (0.36—0.38 mm)

The thickness is etched on each shim. If necessary, measure the thickness with a micrometer.

Three shims of the required thickness are to be installed in each case.

Never use more than one paper gasket.

#### Example:

Distance crankshaft face/main bearing No. 1 ..... 4.265 mm  
 Depth of crankshaft seat in flywheel ..... — 3.215 mm  
 1.050 mm

Thickness of paper gasket when installed ..... + 0.15 mm  
 1.200 mm

Shims to be used: two shims of 0.36 mm each, one shim of 0.38 mm. — 1.100 mm  
 End Play ..... 0.100 mm

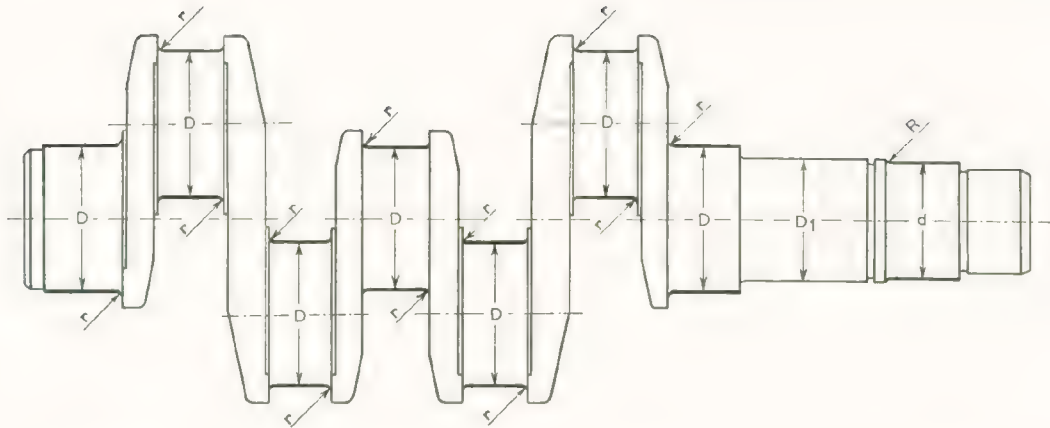
## Reconditioning Crankshaft

Crankshaft needing an overhaul should, if possible, be sent to the factory, as regrinding requires first class equipment and should be undertaken only by those skilled in such work.

If, for some reason, it should not be possible to send in the crankshaft for reconditioning, the following details will be found helpful:

	Main Bearings 1-3 Connecting Rod Bearings (Main Bearing 4)	Bearing Journals and Crank Pins D		Bearing Journal d	
		Ground Diameter mm ins.	Lapped Diameter mm ins.	Ground Diameter mm ins.	Lapped Diameter mm ins.
Standard	50.00 mm Ø 1.9685'' (40 mm/1.5748'')	—	49.991 1.9681 49.975 1.9675	—	40.000 1.5748 39.984 1.5742
1st Undersize	49.75 mm Ø 1.9586'' (39.75 mm/1.5649'')	49.750 1.9586 49.741 1.9583	49.741 1.9583 49.725 1.9577	39.760 1.5653 39.750 1.5649	39.750 1.5649 39.734 1.5643
2nd Undersize	49.50 mm Ø 1.9488'' (39.50 mm/1.5551'')	49.500 1.9488 49.491 1.9484	49.491 1.9484 49.475 1.9478	39.510 1.5555 39.500 1.5551	39.500 1.5551 39.484 1.5545
Re-Harden Journals and Pins! Minimum Hardness Rc 48					
3rd Undersize	49.25 mm Ø 1.9390'' (39.25 mm/1.5453'')	49.250 1.9390 49.241 1.9386	49.241 1.9386 49.225 1.9380	39.260 1.5457 39.250 1.5453	39.250 1.5453 39.234 1.5446
4th Undersize	49.00 mm Ø 1.9291'' (39.00 mm/1.5354'')	49.000 1.9291 48.991 1.9288	48.991 1.9288 48.975 1.9281	39.010 1.5358 39.000 1.5354	39.000 1.5354 38.984 1.5348
The crankshaft is lapped to final size. Strictly keep to the dimensions given.					





$$D = \frac{42.006}{41.995} \text{ mm } \varnothing (1.6538''/1.6533'')$$

$$R = 4.0 \text{ mm } (0.16'')$$

$$r = \frac{2.0}{1.5} \text{ mm } (0.08''/0.06'')$$

The thorough grinding of the radii (r) is of great importance to the life of the crankshaft. If necessary, repolish the radii.

The bearings are marked for easy identification. The numbers in parenthesis indicate the undersize.

	Main Bearing 1	Main Bearing 2	Main Bearing 3	Main Bearing 4	Connecting Rod Bearing
Standard	01.14.1.	01.16.1.	01.18.1.	01.20.1.	03.09
1st Undersize	KD.01.(1).14.1.	KD.01.(1).16.1.	KD.01.(1).18.1.	KD.01.(1).20.1.	KD.03.(1).09
2nd Undersize	KD.01.(2).14.1.	KD.01.(2).16.1.	KD.01.(2).18.1.	KD.01.(2).20.1.	KD.03.(2).09
3rd Undersize	KD.01.(3).14.1.	KD.01.(3).16.1.	KD.01.(3).18.1.	KD.01.(3).20.1.	KD.03.(3).09
4th Undersize	KD.01.(4).14.1.	KD.01.(4).16.1.	KD.01.(4).18.1.	KD.01.(4).20.1.	KD.03.(4).09

### Regrinding

On no account must the bearing shells be remachined.

After grinding, remove sharp edges on oil passages by slightly chamfering them. Crankshaft timing gear and distributor drive gear must be a press fit on the crankshaft.

$$\frac{41.995 \text{ mm } \varnothing}{42.006 \text{ mm } \varnothing} = \frac{1.5633''}{1.6538''}$$

In the case of wear, due to the gears having been removed and installed several times, the press fit can be restored by chromium plating or applying the metal spraying method.

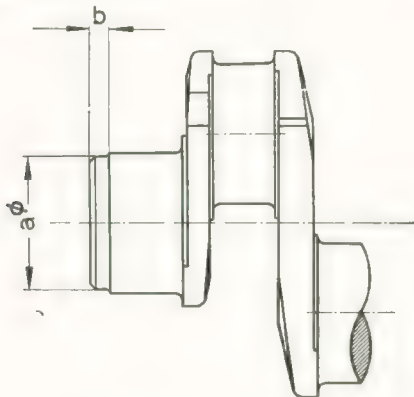
To make sure the crankshaft is free from internal cracks, it is recommended to carry out a "ringing test" prior to installation.

## Re-Hardening

The hardness of the reground bearing points must not be below Rc 48. Regrinding to the 3rd undersize usually necessitates a re-hardening of the journals and pins.

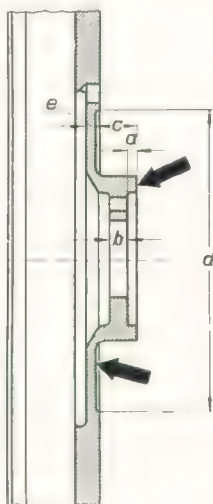
Workshops not having adequate equipment to carry out a correct re-hardening should send the crankshaft to the factory.

Generally, the shouldered flywheel seating is found to have shrunk by the re-hardening process. In such cases, the flywheel seat must be reground to the undersize  $48.0_{-0.06}^{+0.06}$  mm (1.8898'') that is, between 47.984 mm and 48.000 mm (1.8891 and 1.8897''). The standard diameter of the seat is 48.5 mm (1.9094'').



$$a = 48.0_{-0.06}^{+0.06} \text{ mm (1.8898'')} \\ b = 5.9 - 6.1 \text{ mm (0.23 - 0.24'')}$$

A compensating ring (Local Manufacture) is to be inserted into the flywheel and machined to 48.000—48.025 mm  $\varnothing$  (1.8897''—1.8807'').



Should a remachining of the inner crankshaft contact surface in the flywheel become necessary, the same amount of metal must be removed from

the outer contact surface so that the seating depth (a) 3.22—3.25 mm (0.1267''—0.1279'') is retained. The distance (b) must, however, never be below 5 mm (0.2'').

## Remachining Crankshaft and Flywheel

In carrying out the above operations, care must be taken that the length of the flywheel jointing flange (c) 12.50—13.25 mm (0.492''—0.521'') is retained to prevent the flywheel fouling the oil seal or the crankcase. If the length cannot be kept at the specified dimension, the flywheel body should be machined around the flange 110 mm (4.33'') as indicated by (d). The minimum thickness of the flywheel at this point (e) 4.4 mm (0.173'') must, however, be maintained.

The crankshaft end face and the contact surface in the flywheel must be absolutely smooth and square to insure a correct oil sealing. An incorrect mating may also cause a flywheel run-out.

In the case of worn or damaged dowel holes, new holes should be drilled 45° away from the original holes.

Diameter of holes: 6.000—6.012 mm  $\varnothing$  (0.2362—0.2367''). Drill holes, using drill 5.8 mm  $\varnothing$  to a depth of 10.0—10.5 mm (0.39''—0.41''). Ream holes to the above specified size and to a depth of 8.0—8.5 mm (0.314—0.334'').

The specified depth of the holes must be strictly adhered to as otherwise the dowels either go too far into the crankshaft or project too far from the flywheel surface. The following tools should be used to carry out these operations:

Jig VW 231 a for Drilling and Reaming Crankshaft.

Jig VW 231 b for Drilling and Reaming Flywheel.

As the mounting diameter of both jigs amounts to 48.5 mm  $\varnothing$  (1.9024''), the dowel holes should be drilled and reamed prior to re-hardening the crankshaft.

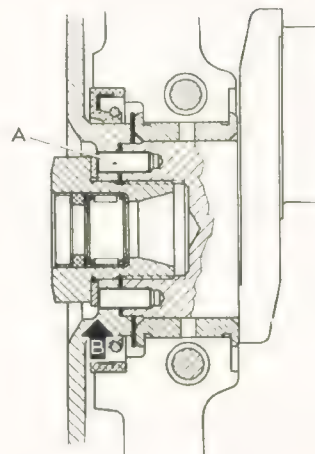
A remachining of the flywheel and a drilling of new dowel holes necessitate in all cases a re-balancing of crankshaft and flywheel.

## Flywheel Dowel Pins

From Chassis No. 1569912 the length of the flywheel dowel pins has been increased from 12.5—0.3 mm (.488"—.012") to 14.0—0.3 mm (.546"—.012") (A).

This measure will insure greater safety against premature wear of the dowel pin holes in the flywheel.

Should it become necessary to overhaul the flywheel, i. e., if the friction area for the crankshaft must be remachined, the dowels should be ground down to 13.0—0.3 mm (.512"—.012") as otherwise the dowel pin ends will protrude over the friction area for the gland nut (B). This would result in a loose fit of the flywheel.



## Oversize Main Bearings for Exchange Engines

Since October 1st, 1956, main bearings with larger outer diameters, according to wear of crankcase bores, are being installed in Exchange Engines. The outer diameter of these bearings is 0.50 mm larger than that of the standard bearings. The main bearing bores in the crankcase have also been enlarged by 0.50 mm.

	Standard	Oversize
Bore for main bearings 1, 2, 3.....	60.000—60.019 mm	60.500—60.519 mm
Bore for main bearing 4.....	50.000—50.025 mm	50.500—50.525 mm

This modification makes it possible to re-use crankcases on which the main bearing bores are excessively worn. It should be observed that oversize main bearings in exchange engines are only installed for the first undersize of the crankshaft.

Exchange Engines provided with oversize main bearings are marked "0" below the engine number.

Part Numbers of main bearings:

Main bearing 1 .....	111105509	Main bearing 3.....	111105569
Main bearing 2 .....	111105539 A	Main bearing 4.....	111105599

From Chassis No. 1538617 all VW engines are now provided with an improved main bearing No. 1. The bearing is provided with a lead coating 0.03 mm (.001") thick and can be recognized by its dull dark-grey colour. On the flywheel side the bearing is provided with four oil pockets.

Bearings of this design have better running qualities.

When engine repairs are carried out the specified play between main bearing No. 1 and the crankpin must not be decreased (0.047—0.102 mm/.0019"—.004").



# Oversize Main Bearings

Main bearings with larger outside diameters are available for service installation to make up for wear in the crankshaft bearing bores. The outside diameter of these bearings is 0.5 mm (.0197'') larger than that of the standard bearings, necessitating the crankshaft bearing bores to be reamed up as specified below:

	Standard size	Oversize
Bores for main bearings 1, 2 and 3 .....	60.000—60.019 (2.3622''—2.3629'')	60.500—60.519 (2.3819''—2.3826'')
Bore for main bearing 4 .....	50.000—50.025 (1.9685''—1.9695'')	50.500—50.525 (1.9882''—1.9892'')

Bearings with larger outside diameter are available for standard size and 1st undersize crankshafts only. Engines on which such oversize main bearings are used should be marked "0" below the engine number.

Main Bearing Part Numbers:

Main bearing	Standard size	First undersize
1	111105503 A	111105509 A
2	111105533 A	111105539 A
3	111105563	111105569
4	111105593	111105599

# Crankcase

From Chassis No. 1587435 the arrangement of main bearing II in the crankcase has been improved as detailed below:

- 1 - The web for main bearing II has been modified by reducing the size of the recess underneath the bearing. This results in increased web strength and rigidity.
- 2 - To compensate for thrust, a 25 mm deep recess has been provided between the set screw of main bearing II and the top parting line.

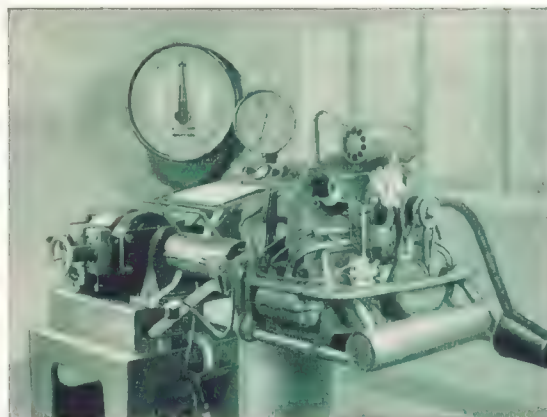
## Breaking-in (Running-in) and Inspection

The service life and efficiency of an engine greatly depends on the way it is treated during the first hours of operation. Great importance should, therefore, be attached to the breaking-in of new or reconditioned engines. The breaking-in is to give all moving parts the final and finest surface treatment. The slightest unevenness in the surface of bearings, cylinders, pistons, etc., will be removed and the parts being exposed to a direct friction prepared to the requirements of an evenly spread oil film, which is a decisive factor for good and lasting engine operation.

The fundamental rules for breaking-in an engine are the following:

- 1 - Let the engine break-in by its own power.
- 2 - Let the engine warm up gradually.
- 3 - Let the engine pick up speed gradually.
- 4 - Let the engine run at higher speed only as long as is necessary to check it for oil leaks, oil pressure, proper functioning of air cooling system, and performance.
- 5 - Let the engine break-in with thin-bodied motor oil of the specification SAE 10 W, 20, or 20 W.

The best means of breaking-in is a test bench provided with a water-brake.



Air brakes are generally cheaper, but the noise caused by the fans in the test room is disadvantageous, especially when trying to locate engine noises. Moreover, air type brakes often do not provide for a checking of the engine torque. On the brake, the engine load can be adjusted within an extensive range, thus meeting the requirements of the breaking-in as well as of performance and fuel consumption tests.

## Major Overhauled Engines

Major overhauled engines have, beside some other renewals, new pistons, cylinders and bearings.

### Pre-Inspection

- a - Adjust valve clearance.
- b - Adjust contact points and set ignition.
- c - Check fan belt tension.
- d - Fill in at least 1½ liter (1½ quart) motor oil of the specification SAE 10 W, 20, or 20 W. Colloidal graphite is not recommended for use during the initial breaking-in period, as it unnecessarily lengthens the breaking-in process. After 1500 km (900 miles) of engine service, colloidal graphite has certain advantages as an additive to regular engine oil. Additive type oils should not be added with graphite.

- e - Check compression.

After warming up the engine, remove all spark plugs. Insert an accredited compression gauge in a spark plug hole and with the throttle in a wide-open position, crank the engine several revolutions with the starting motor and record the reading, which should be between 6.0 and 7.5 atm. (85 lbs./sq. in. — 106 lbs./sq. in.).

### Starting the Engine

Prior to starting, crank the engine several revolutions by hand. If the engine has been standing for a longer period, it is good practice to inject a few drops of oil through the spark plug holes before starting the engine or through the air intake opening of the carburetor while starting the engine.

After the engine has been started, the green oil pressure warning light must go out when the engine picks up speed. The oil circulation has otherwise not attained the correct running pressure to insure an adequate lubrication of the bearings and moving parts.

The red generator warning light must go out no later than at fast idle speed.

### Breaking-in on Test Bench

The breaking-in time of the engine on the test bench may generally be limited to 30 minutes. The engine should run:

#### Load:

- 10 minutes at 1500 r. p. m. 2 kg (4.4 lbs.),
- 20 minutes at 2000 r. p. m. 4 kg (8.8 lbs.).

## Inspecting Engine on Test Bench

### a - Fuel System

After the engine has been started, make sure the fuel pump, fuel lines, and carburetor are leak-proof and test fuel pump pressure. Adjust idling speed.

### b - Fuel Consumption Test at Part-Load

Check fuel consumption towards the end of the half hour of breaking-in. With 8 HP part-load (= 4 kg/8.8 lbs. at the brake) and at 2000 r. p. m., 50 cu. cm. (3 cu. ins.) fuel should be consumed by the engine in 44—48 seconds.

### c - Fuel Consumption and Performance Test

After the engine has been running on the test bench for half an hour, it must be made subject to full load for only 30 seconds at 3000 r. p. m. As soon as this speed has been attained, check fuel consumption. 50 cu. cm. (3 cu. ins.) fuel should be consumed in 19—20.5 seconds corresponding to 25—27 miles/U. S. or 30—32 miles/Imp. gal.

Let the engine slow down no later than after 30 seconds of running at full load, as otherwise the pistons will seize up. Under full load, the performance should not be below 21 HP at 3000 r. p. m. (= 7 kg/15.43 lbs. at the brake).

### d - Generator, Voltage Regulator, Fan

Check generator and voltage regulator for correct function. The fan must not whine at 3000 r. p. m. and must not foul the housing.

An engine is actually broken-in only after 12—15 hours by slowly increasing the load and the speed and can then be made subject to three quarters of the full load for a longer time. After a breaking-in period of 30 hours, the engine may run at full load.

## Final Inspection

### a - Checking for Oil Leaks

After the full load and fuel consumption test, the engine should be checked for oil leaks. Special attention should be paid to valve push rod tubes, oil pump, oil radiator, and crankcase jointing faces.

### b - Oil Change

Drain the engine oil, clean oil strainer and fill in 2½ litres (2½ quarts) of motor oil (breaking-in oil or Motor Oil VW—A 001).

### c - Re-Check

Prior to installation in the car, inspect the engine

for correct adjustment of ignition, valve clearance, and fan belt tension. The air cleaner must be clean.

### d - Storage of Engines

Engines, which will be left standing for a longer time, must be specially treated to prevent damage due to corrosion. Remaining traces of fuel and combustion gas will become chemically aggressive to cylinder walls, valve guides, etc. To prevent damages of this kind, it is recommended to inject corrosion-fighting oil through the air intake opening of the carburetor or the spark plug holes during the last revolutions of the engine before the standstill.

## Partly Reconditioned Engines

If an engine has only been partly reconditioned, e. g., valves renewed and ground-in, the full load test must be carried out not earlier than after 30 minutes of breaking-in time on the engine test bench.

The max. performance must also not be tried before several hours of breaking-in at moderate speed and part-load.

With partly reconditioned engines — especially if crankshaft, bearings, cylinders, and pistons have not been renewed — it is not absolutely necessary to change the oil after the breaking-in on the test bench.

The following points also apply to partly reconditioned engines:

- 1 - Pre-inspection.
- 2 - Checking of fuel system.
- 3 - Fuel consumption test at part-load.
- 4 - Fuel consumption and performance test at full load. Only the fuel consumption figures also apply to partly reconditioned engines. The performance will, according to the engine condition, be higher.
- 5 - Checking for oil leaks.
- 6 - Final inspection.



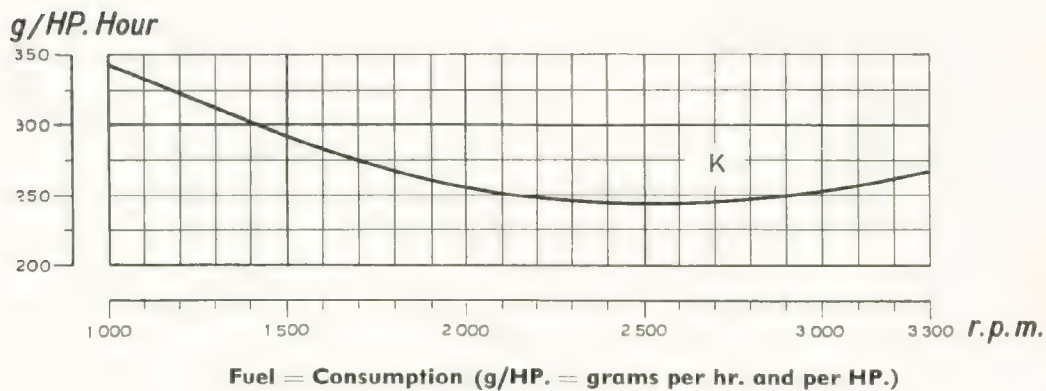
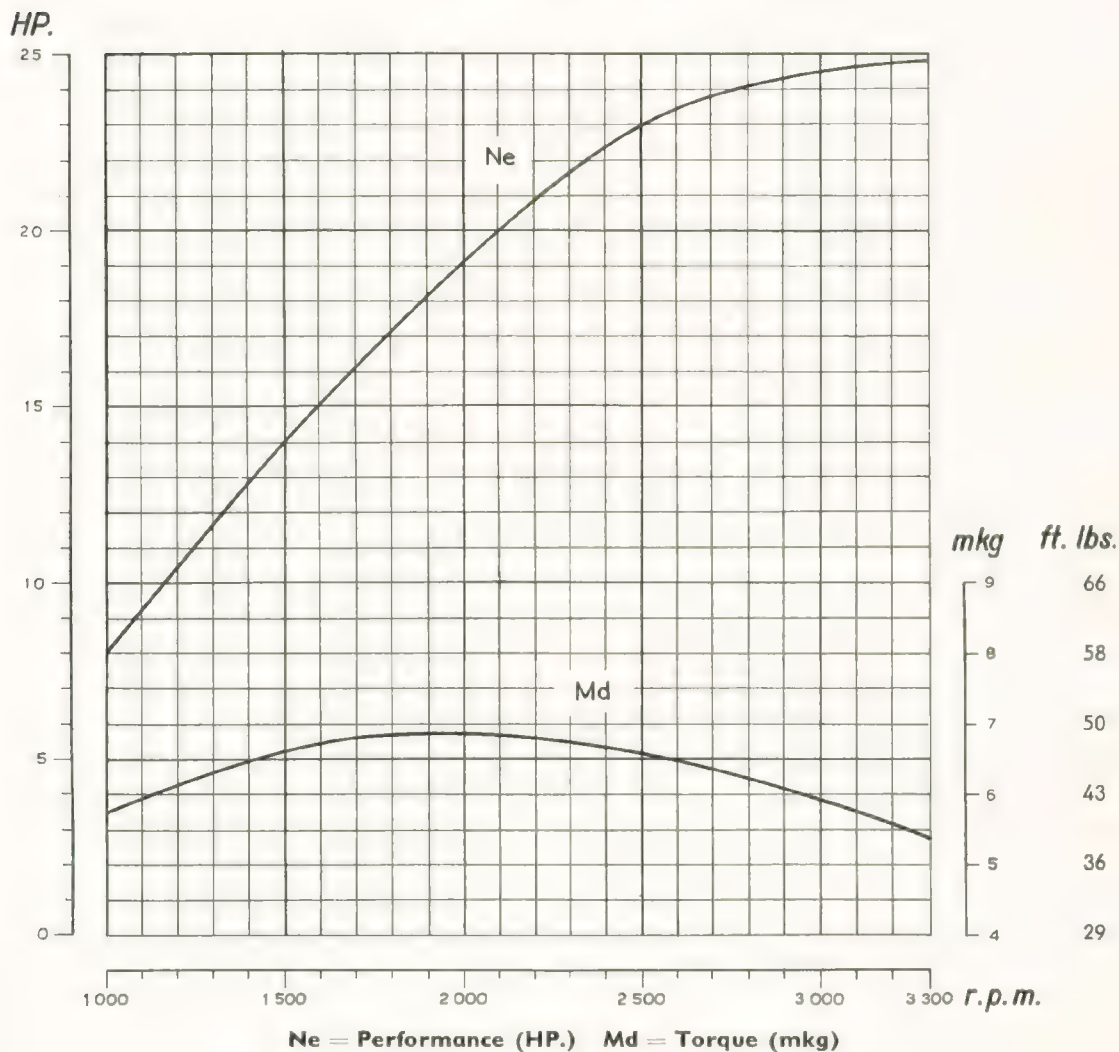


# Volkswagen Engine

1131 c. c. 25 HP.

M

## Power Curves





# Volkswagen Engine

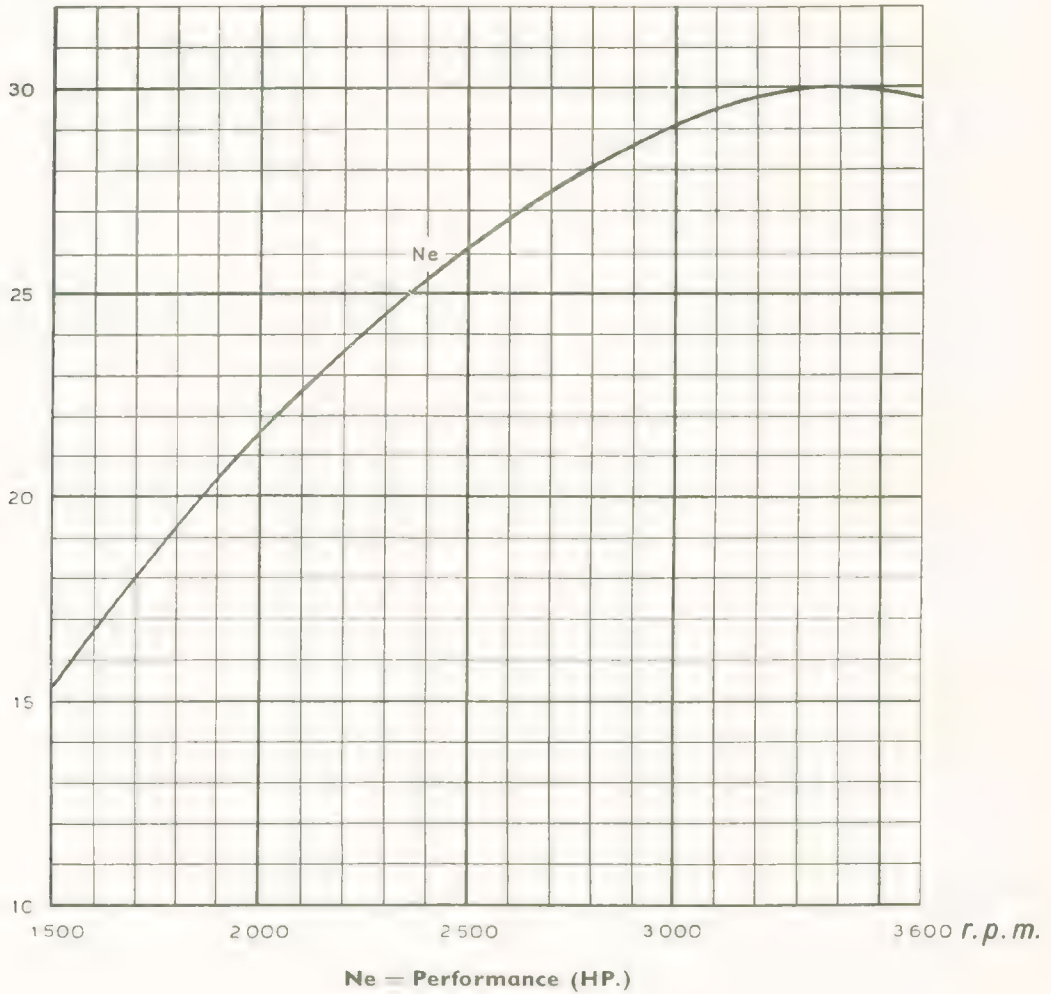
1192 c. c. — 30 HP.

(Effective from January 1954)

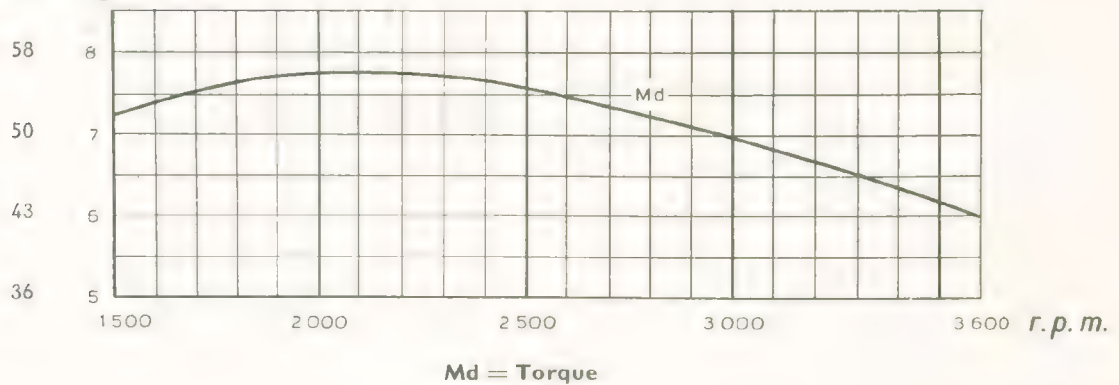
# M

## Power Curves

HP.

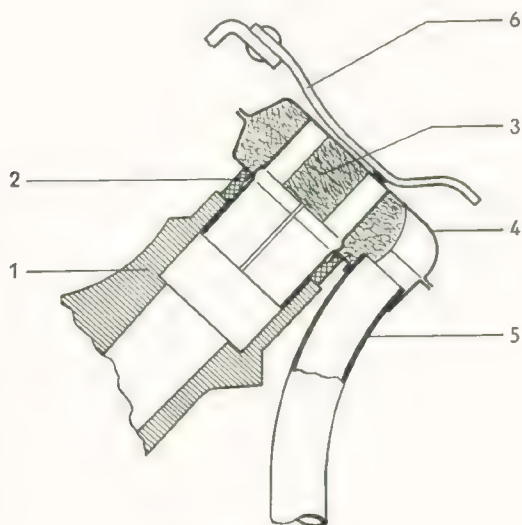


ft. lbs. mkg



## Crankcase Breathing

The breather at the oil filler tube is to allow oil fumes to escape from the crankcase. Up to Chassis No. 1—0678201, the filler cap was provided with a filter element. Filler caps, both with and without filter elements, should be cleaned in benzine at intervals depending on the operating conditions of the cars and each time the engine comes in for an overhaul.



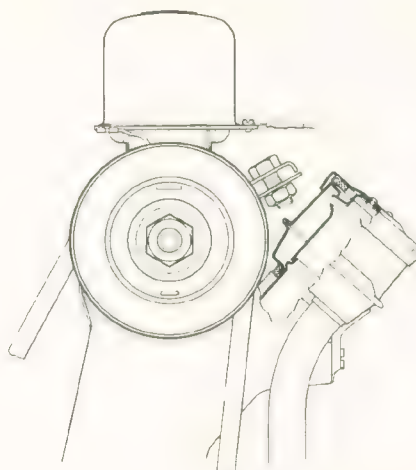
- 1 - Oil filler tube
- 2 - Rubber seal
- 3 - Filter element
- 4 - Oil filler cap
- 5 - Breather pipe
- 6 - Hold-down spring

Breathers that are clogged up by dust or corrosion lead to excess pressure in the crankcase, resulting in loss of oil at the fan pulley. If a thorough cleaning of a filler cap with filter element does not stop the oil leak, the filter element should be removed from the cap and discarded.

### Note:

From Chassis No. 1—0931501 the new breather tube is screwed to the crankcase. To fill the engine with oil, only the filler cap is removed instead of the whole breather tube as before.

A rubber grommet between breather tube and engine rear cover plate avoids ingress of dust and frictional noise. The cover plate flange has been altered to facilitate the installation of the plate.

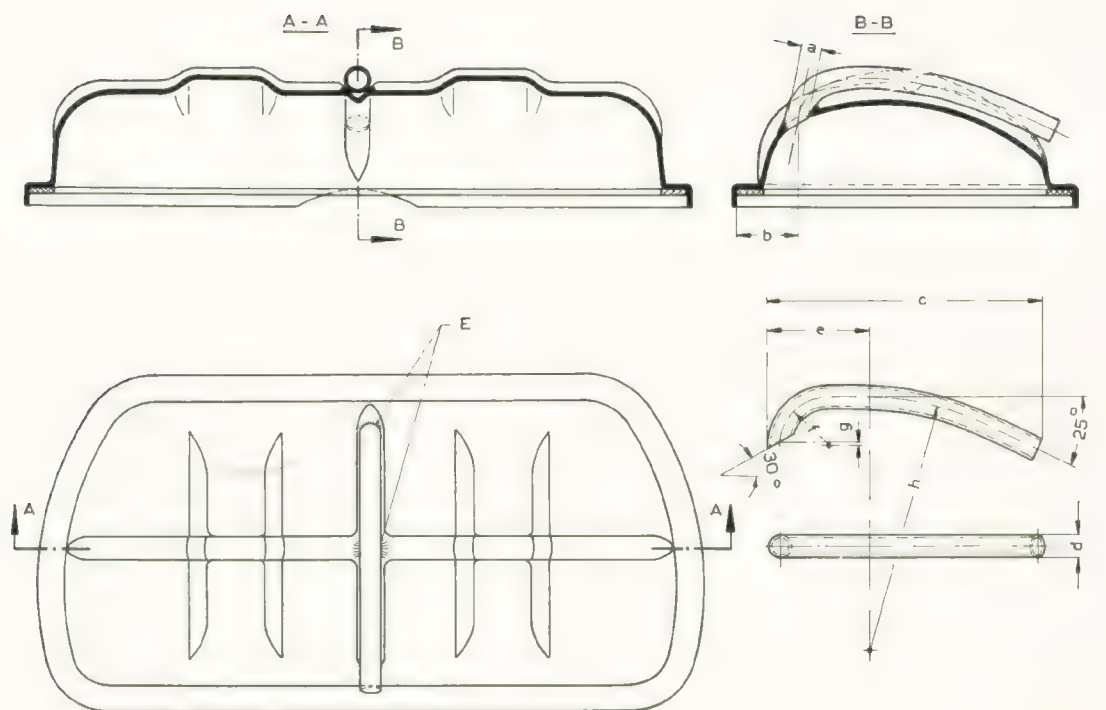


### Note:

The breather hole at the valve chamber of the cylinder heads and the corresponding filter element were omitted with effect from Chassis No. 1—0678201.

If the oil continues to be forced out at the fan pulley, although the breathing passage is free, the below specified breather can be made locally and fitted to the cylinder head cover. The cover, complete with breather, is also obtainable as a spare part.





E = brazed  
a = 8.5 mm dia. (0.335")    b = 20.0 mm (0.787")    d = 8.0 x 1.0 mm (0.315 x 0.04")    f = 16 r    h = 87 r  
c = 94.0 mm (3.7008")    e = 34.0 mm (1.339")    g = 1.0 mm (0.04")

## Interchangeability of Engine Parts

The parts of the 1192 c. c. engine listed below cannot be used on 1131 c. c. engines:

Description	Part No.	Description	Part No.
Crankcase .....	101 021 a	Gasket between crankcase and cylinder .....	101 309 b
Cylinder head .....	101 315 d	Gasket between cylinder and cylinder head .....	101 311 a
Cylinder head stud — AM 10 x 216 .....	101 133 b	Flywheel gland nut .....	105 205 a
Cylinder head stud — AM 10 x 195 .....	101 135 b	Crankshaft pulley .....	105 151 b
Cylinder 77 mm dia., standard .....	101 301 c	Crankshaft pulley, complete .....	903 109 a
Piston 77 mm dia., standard .....	105 451 d	Fan belt .....	903 137 b
Compression ring, upper, 77 mm dia. ....	105 461 b	Carburetor 28 PCI .....	129 021 d
Compression ring, lower, 77 mm dia. ....	105 471 b	Intake manifold .....	129 501 d
Oil ring                      77 mm dia. ....	105 481 b	Gasket for intake manifold .....	N 13821
Intake valve                30 mm dia. ....	109 601 a	Ignition distributor VJU 4 BR 3 mk ...	11 919 021

## Intake Manifold with Special Jacket to Intensify Pre-Heating

The above induction manifold intensifies the pre-heating of both engine sides by the pre-heating tube running parallel with the induction manifold and by an aluminium jacket embracing both tubes. It provides a better fuel/air mixture at extremely low temperatures and permits a more economical fuel consumption.

This type induction manifold may be installed, if an excessive fuel consumption should occur on account of special operating conditions (e. g., if exclusively using the car in dense city traffic or over short distances) at low outside temperatures.

At the beginning of the warmer season the throttle should be placed under the lefthand flange of the pre-heating tube, as the engine will otherwise tend to pink.

With engines having a connecting pipe (up to Chassis No. 1—338058) between the lefthand rear exhaust pipe and the low pressure chamber of the silencer, the throttle should be placed under the righthand flange of the pre-heating tube.

The above induction manifold for intensified pre-heating can be obtained on request from the Spare Parts Department under the number 111 129 703. The flange throttle can be obtained under the number 111 129 715.

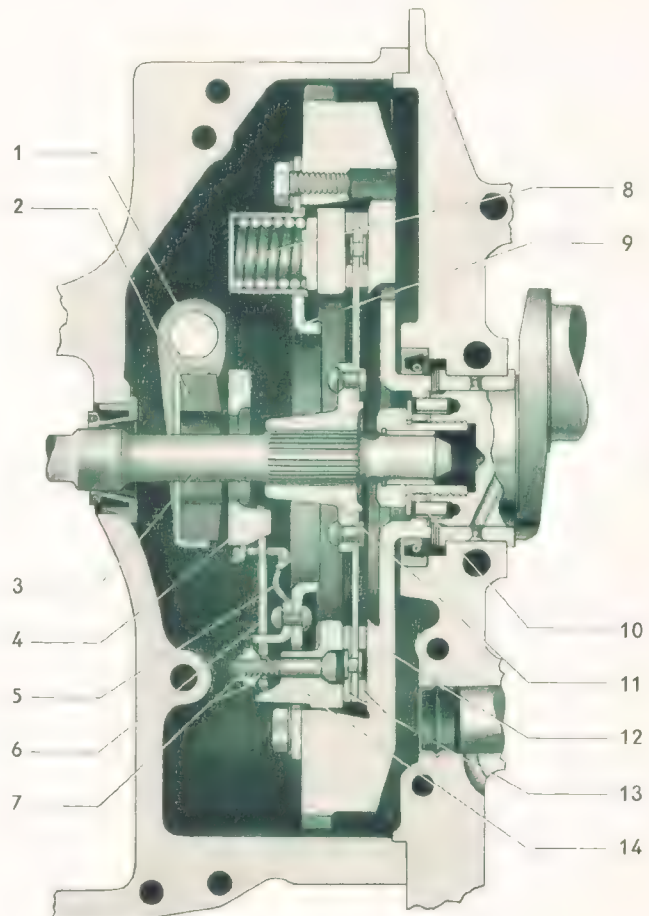
## General Description

The single-plate, dry disc type clutch between engine and transmission is fitted to the flywheel. The driven plate (disc) to which the friction linings are riveted is splined to the main drive shaft. The clutch cover, which carries pressure plate, thrust springs, release levers and release plate, is bolted centrally to the flywheel. When engaged, the driven plate is forced against the flywheel by the spring-loaded clutch pressure plate. Thus the engine power is transmitted to the transmission.

Clutch operating shaft and clutch release bearing are located in the transmission case. The release bearing carries a carbon thrust ring and requires no service or maintenance attention.

## Sectional View

- 1 - Operating shaft
- 2 - Carbon thrust ring
- 3 - Main drive shaft
- 4 - Release plate
- 5 - Release lever spring
- 6 - Release lever
- 7 - Bolt and special nut
- 8 - Thrust spring
- 9 - Cover
- 10 - Pilot bush
- 11 - Driven plate (disc)
- 12 - Flywheel
- 13 - Lining (facing)
- 14 - Pressure plate



## Operation

Release is accomplished by depressing the clutch pedal. The pedal movement is transmitted through the clutch pedal shaft and a cable in the frame tunnel to the release mechanism. As pressure is applied to the pedal, the release levers are moved inward by the release bearing and the pressure plate is moved away from the driven plate, disengaging the clutch.

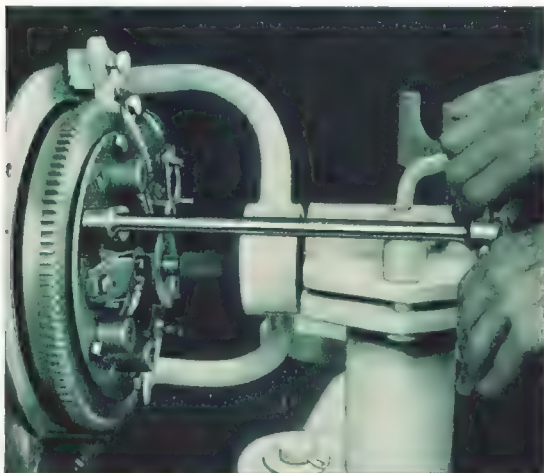
## Adjustment

A readjustment of the clutch pedal free play (10—20 mm/0.4"—0.8") is called for from time to time as the clutch lining wears away. An adjustment of the clutch itself is only necessary when the clutch is disassembled for replacement of parts. This adjustment is carried out at the flywheel or by means of the Clutch Adjustment Gauge VW 254.



## Removal

- 1 - Remove engine.
- 2 - Evenly release clutch cover securing bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion due to the reaction of the thrust springs.

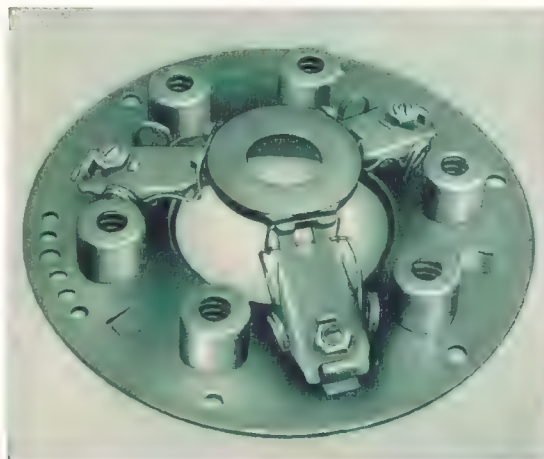


- 3 - Take off clutch cover.
- 4 - Withdraw clutch driven plate.

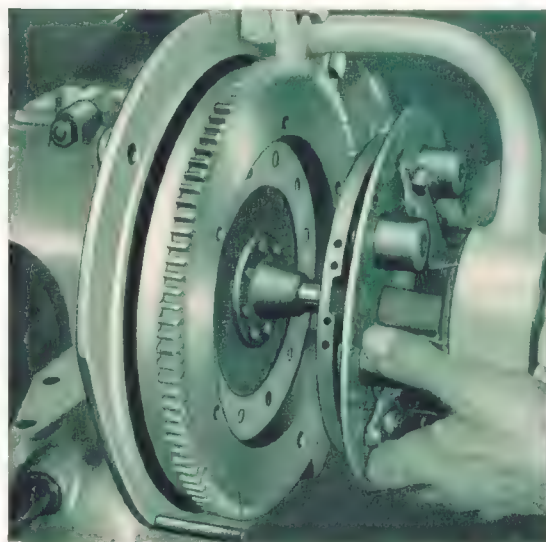
## Installation

Replacement is a reversal of the above, but it is essential to observe the following points:

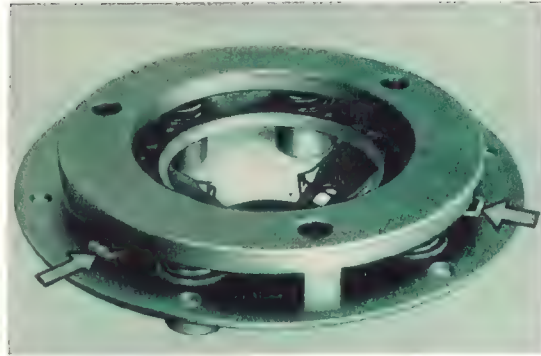
- 1 - Clean clutch contact surface in flywheel and inspect it for wear. Regrind as necessary (max. 0.2 mm/0.008") and polish, using fine emery cloth. Replace flywheel if necessary.
- 2 - Inspect clutch driven plate for wear of linings (facings), run-out, and correct setting of cushion segments. Should it be necessary, renew linings or complete clutch driven plate.
- 3 - Inspect clutch pressure plate for wear and distortion. An uneven contact surface of the pressure plate causes the clutch to chatter and grab. Regrind contact surface or renew pressure plate as necessary.
- 4 - Examine release levers and springs and renew them if found necessary.



- 5 - Inspect release plate for wear and damage, renew if necessary. Check parallelism and distance between release plate and clutch cover bearing surface on flywheel. Readjust release plate as necessary. Renew damaged or coloured release plate caused by undue heat.
- 6 - Check carbon thrust ring for wear and cracks. Renew complete release bearing should it be found necessary. Note correct position of retaining clips.
- 7 - Inspect bearing points of clutch operating shaft in transmission case for wear.
- 8 - Fill pilot bush in flywheel gland nut with about 10 gr. Universal Grease VW-A 052.
- 9 - Reinstall clutch driven plate, using Pilot Mandrel VW 219 to ensure a correct centering.



10 - Evenly tighten clutch cover securing bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion due to the reaction of the thrust springs. Note proper position of clutch cover locating lugs in flywheel.



## Clutch

From Chassis No.: (about) 1 657 072  
Previously from Chassis No. 1 1378864—1383864  
and 1408860—1413860

As from the date specified above, a modified version of the clutch used up to now is being fitted in VW Passenger Cars.

The cross section of the clutch thrust spring has been reduced. The clutch linings are made of "Textar 50 S" or "Beral 1533/9 M".

The "Textar 50 S" lining is interspersed by a thin, continuous brass wire and is also marked by a square stamp. The brass wire of the "Beral 1533/9 M" lining is visibly arranged in a honeycomb pattern.

The thrust spring sleeves have a square hole for identification of these clutches.

The purpose of this modification is to reduce the foot pressure required at the clutch pedal.

Clutch plates of the former design may be exchanged for plates of the new type. In the opposite case, it will be absolutely necessary to replace the new clutch thrust springs and sleeves by those of the older type.

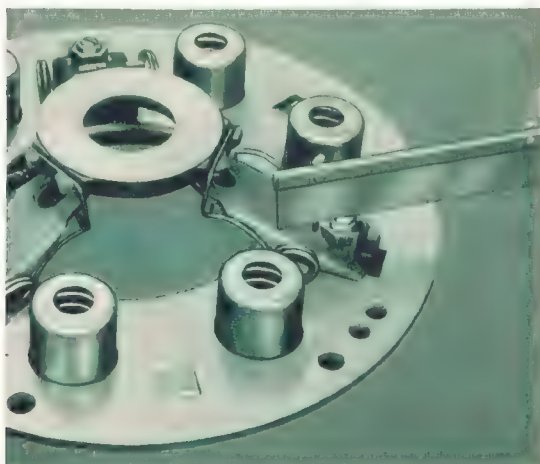
### Attention

In the event of repairs, 6 springs of the new type or 6 springs of the old type have to be fitted. Never replace springs individually.

## Clutch Disassembly

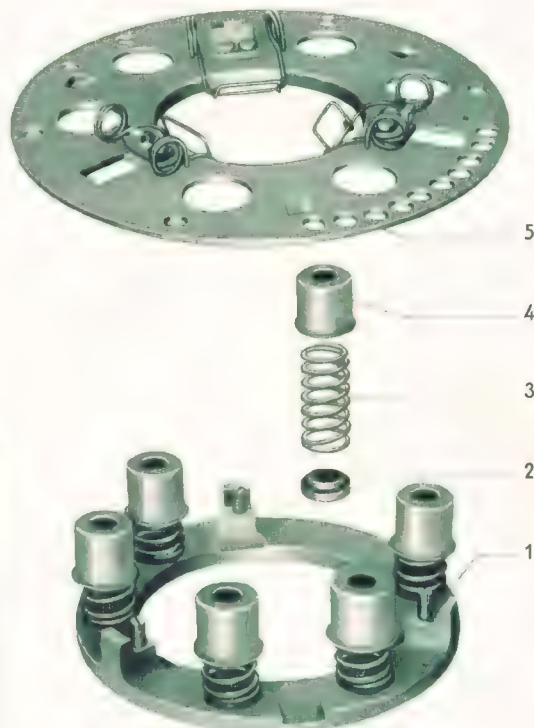
### Disassembly

- 1 - Remove clutch.
- 2 - Install clutch cover and pressure plate in Clutch Adjustment Gauge VW 254 (with gauge ring) or in flywheel (with clutch driven plate) and tighten by means of the six clutch cover securing bolts. Evenly tighten the bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion. Mark all parts in some way so that they may be reassembled in the same position, should new parts be unnecessary, as the clutch must otherwise be rebalanced.
- 3 - Undo the special nuts securing the release levers, using a saw to remove the metal peened over. Lift off release levers together with the springs and the release plate.



- 4 - Evenly release clutch cover securing bolts and take off clutch cover. Remove thrust springs, spring seats, and pressure plate.

Carefully inspect all clutch components before reassembly.



Arrangement of thrust springs

- 1 - Pressure plate
- 2 - Spring seat
- 3 - Thrust spring
- 4 - Spring cap
- 5 - Clutch cover

## Clutch Cover and Pressure Plate

### Inspection

- 1 - Check clutch cover for distortion and straighten it as necessary. Distortion of the cover is mostly a result of an uneven tightening or releasing of the bolts.
- 2 - Thoroughly clean pressure plate and inspect it for distortion, wear, and cracks. The contact surface of the pressure plate must bear evenly all the way round to avoid clutch chattering. Should the run-out be in excess of 0.1 mm (0.004"), the pressure plate may be reground and polished. The pressure plate must otherwise be replaced.

- 3 - Examine thrust springs.

Free Length:	51.7 mm/2.03"
Loaded Height:	29.4 mm/1.16"
Load:	57.5 ± 2.5 kg
Permissible Loss of Load down to:	49 kg

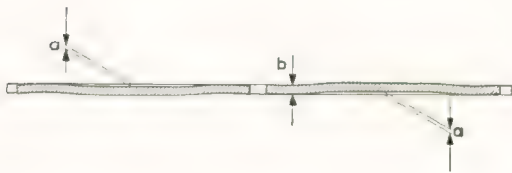
- 4 - Inspect release plate for wear and damage. Renew damaged or, due to undue heat development, coloured release plate.



# Clutch Driven Plate

## Inspection

- 1 - The clutch driven plate has twelve cushion segments. The cushion segments are set alternatively concave and convex. It is essential to a perfect operation of the clutch that the segments are equally set.



$$a = 0.4-0.6 \text{ mm (0.016"-0.024")}$$

$$b = 1.2 \text{ mm (0.047")}$$

The hub of the plate must slide freely on the splined main drive shaft without undue radial clearance. Worn parts are to be renewed.

- 2 - Inspect clutch linings. Renew linings if they are oily, burnt, cracked, or nearly worn down to the rivets.

**Important.** — Only accredited clutch lining (facing) must be used. This is especially important for cars equipped with synchromesh type transmission.

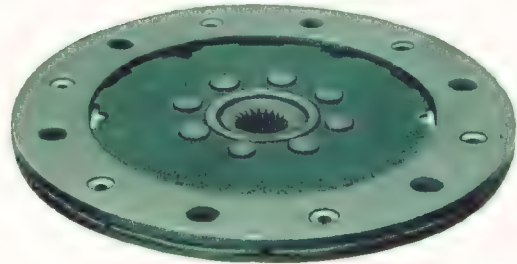
## Clutch Linings (Facings)

Outer Diameter 179.0—181.0 mm/7.04—7.12"  
 Inner Diameter 124.0—125.0 mm/4.88—4.92"  
 Thickness 3.4— 3.6 mm/0.13—0.14"

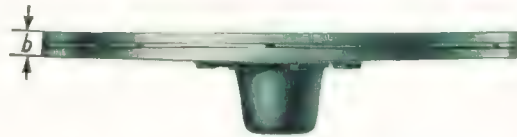
When riveting clutch linings to the cushion segments, it should be noted that every second hole is countersunk. The clutch linings on either side of the plate are individually riveted to the segments, that is, each of the two linings is attached to the plate with a separate set of rivets.



The linings are fastened to the convex side of the cushion segments.

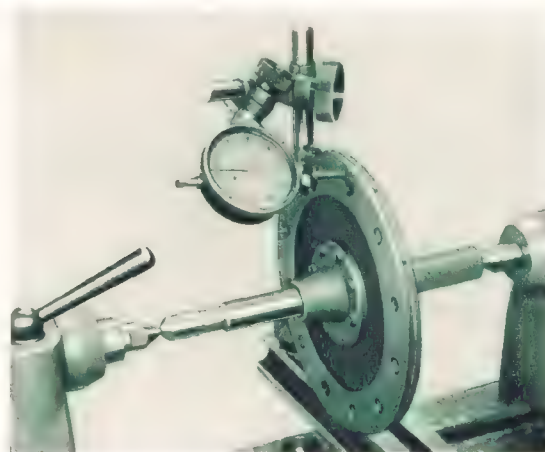


- 3 - Check distance between friction faces of the clutch driven plate.



$$b = 8.6 \text{ to } 9.2 \text{ mm (0.34" to 0.36")}$$

- 4 - Check clutch driven plate for run-out with linings assembled. Permissible run-out: max. 0.5 mm (0.02").



## Assembling Clutch

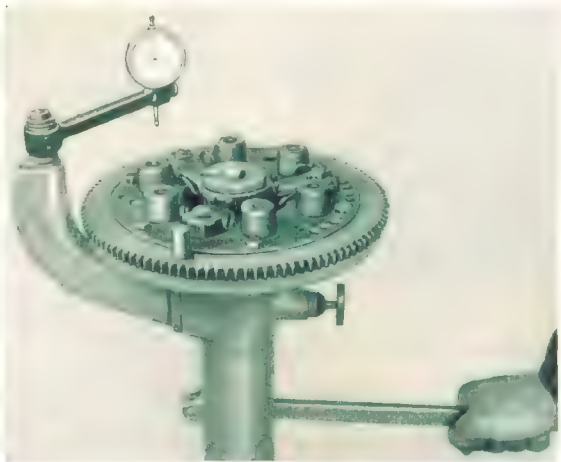
### Assembly

This is a reversal of the disassembly, but the following points should be noted.

- 1 - Place gauge ring in the Clutch Adjustment Gauge VW 254.



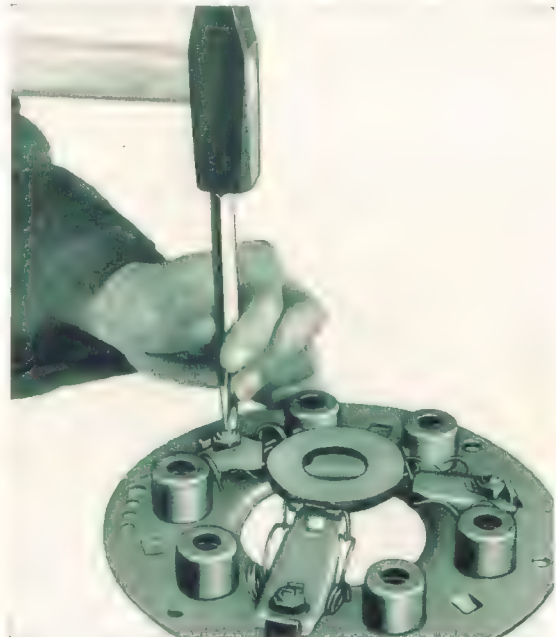
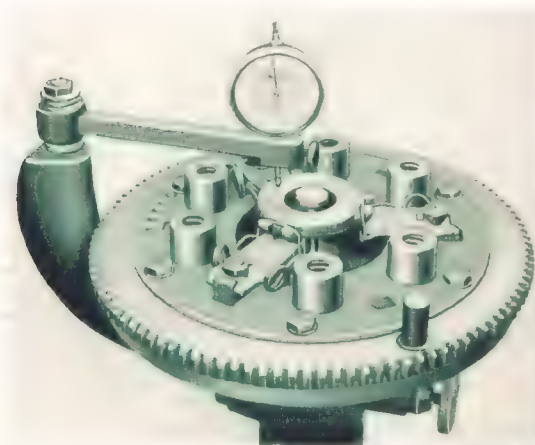
The distance between release plate and clutch cover bearing surface on flywheel amounts then to 26 mm (1.02"). Put the C-washer on release plate and load the clutch by pressing the lever several times downwards.



- 2 - Evenly tighten the clutch cover securing bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion
- 3 - Lightly grease the moving joints of the release levers, using Special Grease VW-A 051.
- 4 - Renew release lever special nuts and bolts if these have become unserviceable in disassembly.
- 5 - Adjust dial gauge to zero position on adjusting pin. Place tracer pin of dial gauge on release plate. Tighten special nuts at the release levers until the zero position on the gauge is restored.

Recheck the distance of 26 mm (1.02") from release plate to clutch cover bearing surface on flywheel. The parallelism of the release plate can then be checked by rotating the flywheel. Permissible run-out of release plate max. 0.3 mm (0.012").

- 6 - The height and parallelism of clutch release plate may also be checked by means of a straight edge and a depth gauge.
- 7 - Secure special nuts using a peening tool.



From Chassis No. 1631980 the distance between the clutch cover contact face at the flywheel and the clutch release plate is

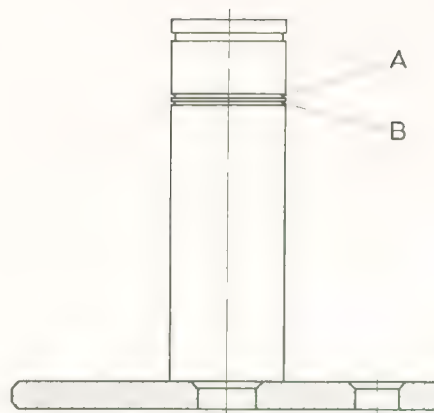
now: 27 mm  
(formerly: 26 mm)

This modification provides increased safety against incomplete clutch release.

Clutch assemblies of vehicles built prior to the introduction of this modification should be adjusted accordingly when brought in for corresponding repairs.

The testing plate of special tool VW 254 a should be modified in accordance with the drawing.

The bottom edge of groove (B) which has to be subsequently provided, should be 1 mm deeper than that of the existing groove (A).

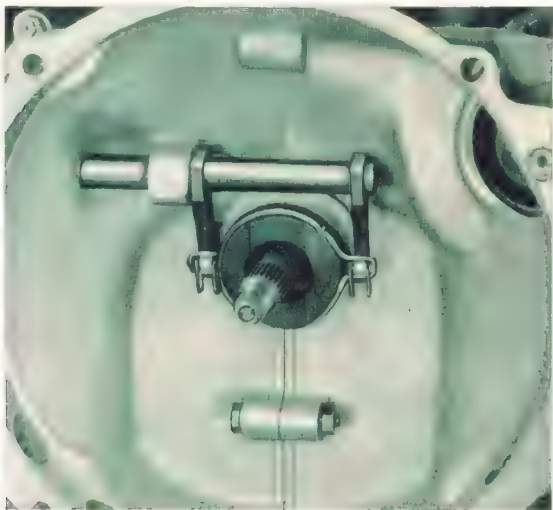




## Removing and Installing Clutch Release Bearing

### Removal

- 1 - Remove engine.
- 2 - Remove clutch release bearing retaining springs.
- 3 - Withdraw release bearing.



### Installation

This is a reversal of the preceding operations, but attention should be paid to the following points:

- 1 - Inspect carbon thrust ring of release bearing for wear and cracks. Renew release bearing should the carbon thrust ring be damaged. The ring must not be replaced separately as it will definitely suffer damage when pressing it in position.
- 2 - Note correct position of retaining springs.
- 3 - Readjust clutch pedal free play after engine has been installed.

## Removing and Installing Clutch Operating Shaft

### Removal

- 1 - Remove engine and transmission.
- 2 - Disassemble transmission case.
- 3 - Unscrew nut at clutch operating lever and withdraw lever together with return spring and spring seat.

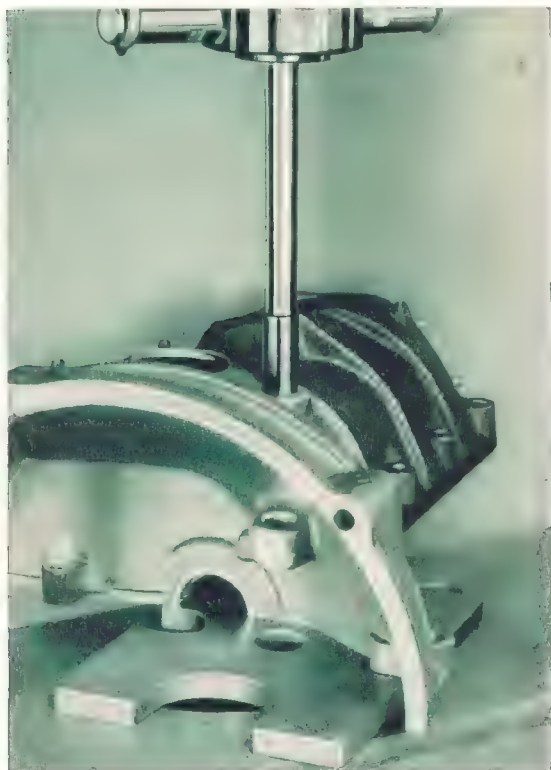
- 4 - Pull out operating shaft.



### Installation

Installing clutch operating shaft is a reversal of the removal procedure, but the following hints should be noted:

- 1 - Inspect operating shaft and bushes in transmission case for wear. Renew if necessary.



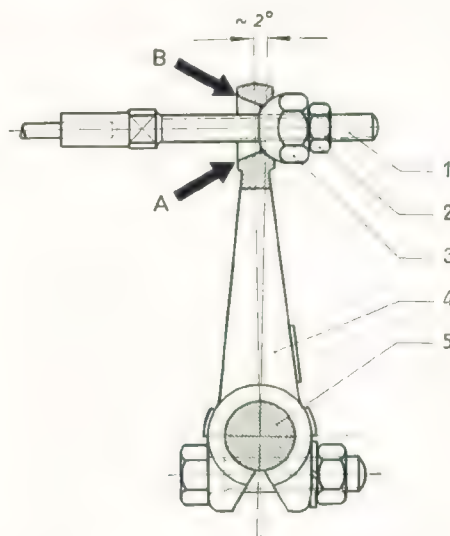
- 2 - Apply Special Grease VW A—051 when installing operating shaft.
- 3 - Check return spring and renew it when found to be weak.
- 4 - With the clutch correctly adjusted, check position of operating lever.

The position of the operating lever is correct, if:

- a - **with clutch engaged**, the clutch cable threaded end piece only lightly touches the lower edge (A) of the bevelled hole in the lever;

- b - **with carbon thrust ring just touching release plate**, the inclination of the lever towards the front is not in excess of  $2^\circ$ ;

- c - **with clutch fully released**, the upper edge (B) of the bevelled hole is not forced against the threaded end piece.



- 1 - Clutch cable threaded end piece
- 2 - Lock nut
- 3 - Adjusting nut
- 4 - Operating lever
- 5 - Operating shaft

A wrong position of the lever due to the clutch being mal-adjusted, an excessively worn carbon thrust ring, or a restricted movement of the adjusting nut in its concave seating are liable to cause a buckling at the threaded end piece and may eventually lead to breakage of the cable.

The following hints should be noted to prevent breakage:

- a - Renew release bearing if badly worn.
- b - Grease the adjusting nut with Universal Grease VW A—052 when carrying out inspections or repairs.

## Removal

- 1 - Raise rear end of car and remove left-hand rear wheel.
- 2 - Disconnect clutch cable from clutch operating lever on transmission case.



- 3 - Withdraw rubber boot from conduit tube and pull out clutch cable from rubber boot.

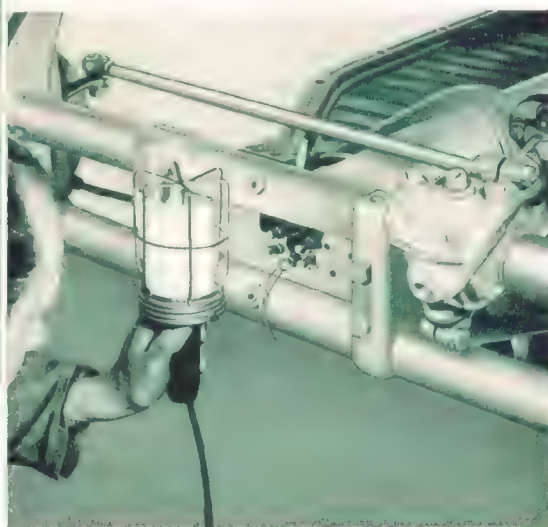


- 4 - With the mechanical brake, withdraw the brake push bar 5—10 cm (2"—4") towards the front.
- 5 - With the hydraulic brake, disconnect the piston push rod of the brake master cylinder.
- 6 - Disconnect accelerator cable.
- 7 - Remove pedal linkage.
- 8 - Pull out clutch cable through the hole for the pedal linkage in the frame tunnel.

## Installation

Installing the clutch cable is a reversal of the removal procedure, but the following points should be heeded:

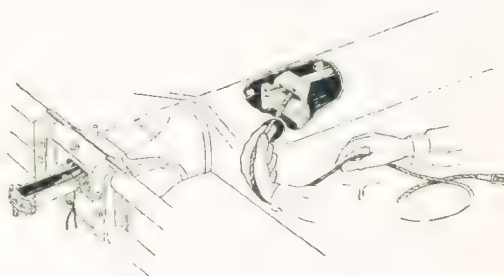
- 1 - Inserting the cable into the conduit tube can best be carried out with another mechanic guiding the operation from the frame head or through the front inspection holes with the body



in situ, using an inspection lamp. A pushed-in cable which missed the opening of the conduit tube is liable to become jammed in the tunnel, making a removal extremely difficult.

- 2 - Grease clutch cable with Universal Grease VW A—052.

- 3 - Insert clutch cable through the hole in the frame tunnel and see that the end of the cable goes into the slit of the conduit tube as shown below.

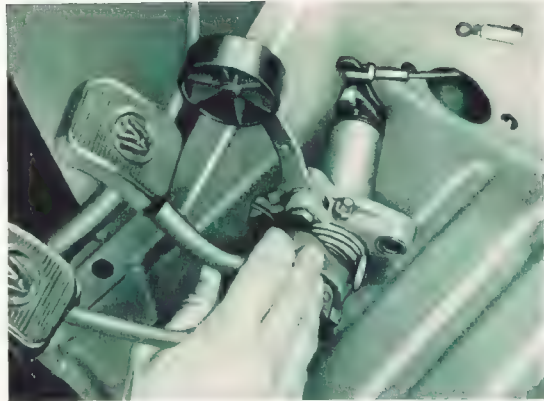




Lead the cable with the left hand, while pushing is forward with the right hand until the threaded cable end has fully entered the conduit tube. Then push the cable completely through the tunnel.

The clutch cable guide tube at the end of the frame tunnel should bend down 20 or 30 mm (.8" or .12'). This tension of the guide tube is obtained by inserting washers between the bracket at the transmission and the end piece of the guide tube.

- 4 - Note correct position of the rubber boot at the end of the conduit tubes.
- 5 - Grease clutch cable eye and clutch pedal shaft with Universal Grease VW A — 052.
- 6 - With the cable eye attached to the hook, the clutch pedal must be held in a vertical position to prevent the cable becoming disconnected. It is also recommended in this connection that an assistant pulls a tension at the other end of the cable.



- 7 - See to it that the pedal stops are in correct position. With the hydraulic brake, the piston push rod must have a clearance of 1 mm (0.04") in the piston.
- 8 - Grease clutch cable adjusting nut with Universal Grease VW A — 052.
- 9 - Adjust clutch pedal free play.

## General

The clutch is to be adjusted so that there is a clearance of 1—2 mm (0.04"—0.08") between the carbon thrust ring of the release bearing and the clutch release plate with the clutch engaged. Measured at the clutch pedal, this clearance amounts to a pedal free play of 10—20 mm (0.4"—0.8"). The clearance may be adjusted at the adjusting nut on the cable end.

As the wear on the clutch lining increases, the clearance between the carbon thrust ring and the release plate is reduced until these two parts contact each other. This condition leads to excessive wear or damage. At the same time it reduces the clutch pressure which is liable to result in a slippage and burning of the lining.

## Adjustment

- 1 - Release lock nut on the threaded cable end.



- 2 - Adjust clutch clearance by turning the adjusting nut on cable end until the clutch pedal free play amounts to 10—20 mm (0.4"—0.8"). Depress clutch pedal several times and recheck pedal free play.



$$a = 10 - 20 \text{ mm (0.4" - 0.8")}$$

- 3 - When the correct adjustment has been reached, hold adjusting nut and tighten lock nut against it.
- 4 - Grease clutch cable adjusting nut with Universal Grease VW A—052.



## Clutch Trouble Checking

Symptom	Cause	Remedy
1. Noise	<ul style="list-style-type: none"><li>a - Pilot bush in flywheel gland nut worn</li><li>b - Carbon thrust ring excessively worn</li><li>c - Driven plate fouling pressure plate</li><li>d - Weak release lever springs or unequal tension</li></ul>	<ul style="list-style-type: none"><li>a - Renew bush and fill it with 10 gr. Universal Grease VW — A 052</li><li>b - Renew carbon thrust ring. See to it that release plate and clutch clearance are correctly adjusted. Tell driver not to use clutch pedal as a foot rest</li><li>c - Renew or straighten driven plate</li><li>d - Renew springs</li></ul>
2. Chatter or Grabbing	<ul style="list-style-type: none"><li>a - Transmission case not tightly mounted</li><li>b - Bend of cable guide tube not correct</li><li>c - Grease or oil on driven plate, flywheel or pressure plate</li><li>d - Uneven contact of pressure plate</li><li>e - Release plate not running true</li><li>f - Unequal tension of thrust springs</li></ul>	<ul style="list-style-type: none"><li>a - Tighten mounting bolts and nuts</li><li>b - Correct the bend to 10 or 20 mm (.4'' or .8'')</li><li>c - Renew oil seal. Clean all parts and reline driven plate</li><li>d - Renew or regrind pressure plate</li><li>e - Eliminate run-out. Max. permissible run-out: 0.3 mm (0.012'')</li><li>f - Renew thrust springs</li></ul>
3. Dragging or Incomplete Release	<ul style="list-style-type: none"><li>a - Excessive pedal free play</li><li>b - Distorted driven plate or bent main drive shaft</li><li>c - Cushion segments excessively set or plate linings broken</li></ul>	<ul style="list-style-type: none"><li>a - Adjust clutch clearance: 10—20 mm (0.4''—0.8'') at clutch pedal</li><li>b - Straighten or renew driven plate or main drive shaft</li><li>c - Reline or replace driven plate</li></ul>
4. Slippage	<ul style="list-style-type: none"><li>a - Lack of pedal free play due to wear of linings</li><li>b - Grease or oil on clutch linings</li></ul>	<ul style="list-style-type: none"><li>a - Adjust clutch clearance: 10—20 mm (0.4''—0.8'') at clutch pedal</li><li>b - Replace clutch linings. Replace engine or transmission oil seal if necessary</li></ul>





# Tools and Appliances

# M

## 1 - VW Special Service Tools

VW 109	Box Wrench 10 mm
VW 112	Special Wrench 36 mm with Guide Plate
VW 122 b	Circlip Pliers
VW 123	Piston Ring Compressing Tool 75 mm dia.
VW 123 a	Piston Ring Compressing Tool 77 mm dia.
VW 124	Chisel (Peening)
VW 161 a	Circlip Pliers
VW 163 a	36 mm Socket
VW 165	Socket Wrench for Cylinder Head Nut
VW 201	Oil Pump Extractor
VW 202	Extractor
VW 202 a	Extractor Hooks
VW 202 f	Thrust Pad
VW 203 b	Fan Pulley Extractor
VW 204	Crankshaft Oil Seal Installing Tool
VW 205 a	Electric Piston Heating Tool (75—78 mm dia.)
VW 207	Piston Pin Pilot Drift
VW 207 a	Piston Pin Removing and Installing Tool
VW 212 a	Piston Pin Bearing (little end) Removing and Installing Tool
VW 214	Device for Checking, Straightening, and Reaming Connecting Rods
VW 218	Gland Nut Bush Pilot Drift
VW 219	Clutch Pilot
VW 231 a	Crankshaft Drill Jig
VW 231 b	Flywheel Drill Jig
VW 246	Not-Go Plug Gage
VW 252 d, e, f	Master Ring Gages
VW 253	Valve Guide Plug Gage
VW 254 a	Clutch Adjustment Dial Gage
VW 292	Crankshaft End Play Gage
VW 310	Fixture
VW 311	Valve Extractor
VW 311 b	Valve Grinding Kit
VW 311 c	Chuck
VW 400	Repair Press 15 t
VW 401	Thrust Plate
VW 427	Guide Tube
VW 428	Guide Tube (tapered)

## 2 - VW Workshop Equipment for Local Manufacture

(The earlier VW Numbers are given in brackets)

VW 600	(VW 304) Engine Trolley
VW 603/1	(VW 603 or VW 355/4) Vehicle Trolley
VW 604	(VW 351/1) Ramp
VW 605	(VW 301) Gantry
VW 633	(VW 672 a) Trestle
VW 650	(VW 358 a) Cylinder Retainer
VW 659	(VW 384) Dial Indicator Bracket
VW 660	(VW 385) Straightener for Sealing Sleeve
VW 661/1	(VW 661 and VW 353) Oil Cooler Test Appliance
VW 661/2	(VW 661 and VW 353) Oil Cooler Test Appliance
VW 666	Adjusting Lever for Air Intake Throttle Ring

### 3 - Normal Hand Tools

Screwdriver, 6 mm  
Combination pliers  
Pipe wrench  
Prick punch (center punch)  
Pin punch, 2 mm  
Mechanic's hammer, 300 grams  
Mechanic's hammer, 500 grams  
Rubber mallet, 85 x 50 mm  
Aluminium mallet  
VW Spark plug wrench  
Triangular scraper  
Flat scraper  
Flat file, 180 mm in length  
Socket wrench, 14 mm  
Socket wrench, 17 mm  
Socket wrench, 19 mm  
Open-end wrench, 7 mm  
Open-end wrench, 9 mm  
Open-end wrench, 10 mm  
Open-end wrench, 14 mm  
Open-end wrench, 17 mm  
Open-end wrench, 19 mm  
Open-end wrench, 22 mm  
Box wrench, 10 mm  
Box wrench, 14 mm  
Box wrench, 17 mm  
Box wrench, 19 mm  
Box wrench, 27 mm  
Box wrench, 30 mm  
Wire brush  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl  
Test lamp, 6 volts  
Dial indicator  
Set of feeler gages, 0.1—0.5 mm  
Micrometer caliper, 0—25 mm  
Micrometer caliper, 25—50 mm  
Micrometer caliper, 50—75 mm  
Caliper square, 300 mm in length, measuring 1/50 mm  
Depth gage, 300 mm in length, measuring 1/50 mm  
Straight edge, 1000 mm in length  
Dial gage for checking 18—100 mm inside diameters  
measuring 1/1000 mm  
Tap M 6  
Tap M 8  
Tap M 10  
Tap M 10 x 1.0  
Tap M 12 x 1.5  
Tap M 14 x 1.25  
Tap M 18 x 1.5  
Die M 6  
Die M 8  
Die M 10  
Die M 10 x 1.0  
Die M 12 x 1.5  
Die M 14 x 1.25

Die M 18 x 1.5  
Die stock, size 1  
Die stock, size 2  
Tap wrench, size 1, adjustable  
Tap wrench, size 2, adjustable  
Drill 5.0 mm  
Drill 6.7 mm  
Drill 7.0 mm  
Drill 8.0 mm  
Drill 8.5 mm  
Drill 9.0 mm  
Drill 10.0 mm  
Drill 10.5 mm  
Drill 12.0 mm  
Broach 7 H 7  
Broach 7.008 H 7  
Broach 7.023 H 7  
Torque wrench  
Inspection lamp with cable and plug  
Electric drill  
Oil funnel

#### **4 - Supplementary Workshop Equipment**

Crankcase refacing tool  
Valve spring tester  
Engine test stand  
Valve grinding machine





## Contents:

- 1 - Description**
- 2 - Carburetor**
- 3 - Fuel Pump**
- 4 - Fuel Tank**
- 5 - Special Hints**
- 6 - Tools and Appliances**



# Description of Fuel System

# K

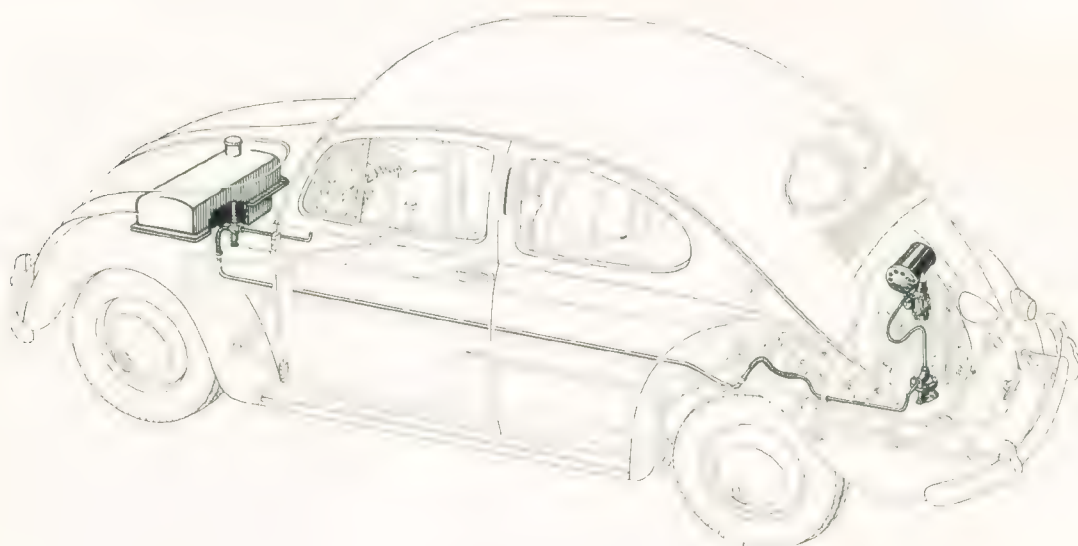
## General Description

The fuel system is composed of the fuel tank, fuel filter, fuel lines, mechanical fuel pump, and the downdraft carburetor and air cleaner.

The fuel tank, having a capacity of 40 liters (10.5 U.S. gals.; 8.8 Imp. gals.), is accessible by lifting the front bonnet. The fuel tap, situated underneath the tank, regulates the flow of fuel and can be operated from the front seats. Its three positions are: shut off, open, and reserve. The fuel reserve (5 liters : 1.3 U.S. gal.; 1.1 Imp. gal.) can only flow out after the tap has been turned to the reserve position.

The mechanical pump serves to draw the fuel from the tank through the fuel line in the frame tunnel and then force it on into the carburetor.

The air drawn in by the carburetor goes through a cleaner to prevent dirt, dust and other abrasive particles from entering the engine.



## Maintenance and Adjustment

The fuel filter must be cleaned regularly at the prescribed intervals. Special care should be taken when filling the tank from cans to avoid dirt and foreign matter entering the tank. It is recommended to filter the fuel through a clean piece of chamois when filling the tank. As an additional precaution, a fine fuel filter may be installed at the fuel pump.

The air cleaner should be serviced in accordance with the instructions given under a separate heading in this section. Under severe dust conditions, the air cleaner must be serviced more frequently than indicated in the Maintenance Chart, in extreme cases even daily.

The fuel pump requires no service attention. The pump pressure should be checked when fuel consumption is excessive or engine cuts out at high speeds.

The carburetor should be cleaned in accordance with the instructions given on later pages in this section. It should also be checked and adjusted to insure good engine performance under all operating conditions (climate, altitude, etc.). If complaints are made in regard to excessive fuel consumption, no attempt should be made to effect a remedy by changing the jets. The first step to be taken in analysing such complaints is to determine the fuel consumption by means of a fuel-mileage tester. Driving habits or abnormal operating conditions are often responsible for an excessive fuel consumption.



# Carburetor

(SOLEX 28 PCI)

# K

## General Description

The **fuel-air mixture** for the engine is produced in the carburetor. The fuel is atomized and thoroughly mixed with air in the correct proportions to assure good engine performance. The operating principles of the downdraft carburetor promote the cylinder filling by making full use of the increasing speed of the air stream. This advantage greatly contributes to the elasticity and performance of the engine and facilitates the starting procedure.

The carburetor has a **central air supply**. This means that the air required for varying operating conditions and for the float chamber ventilation must pass through the air cleaner on top of the carburetor air horn. Thus the ingress of dirt is reduced to a minimum. The design of the float chamber ventilation insures a constant fuel level, even when the air cleaner is clogged. The fuel consumption will, therefore, not be influenced by the degree of dirt accumulated in the air cleaner.

The **preheating** of the intake manifold not only prevents the condensation of fuel vapor, but assures improved engine performance by vaporizing any unvaporized particles remaining in the fuel gas. Thus the mixture is well kept within the explosive range.

The choke valve in the carburetor air horn serves as a **starting device** for cold starting. It is operated through a pull knob on the instrument panel.

The function of the **idling circuit** may be considered as that of an auxiliary carburetor which produces the fuel-air mixture when the throttle is closed or slightly open.

The diaphragm-type **accelerator pump** is linked to the throttle. It causes the engine to pick up speed quickly and aids in securing maximum performance, flexibility, and economy.

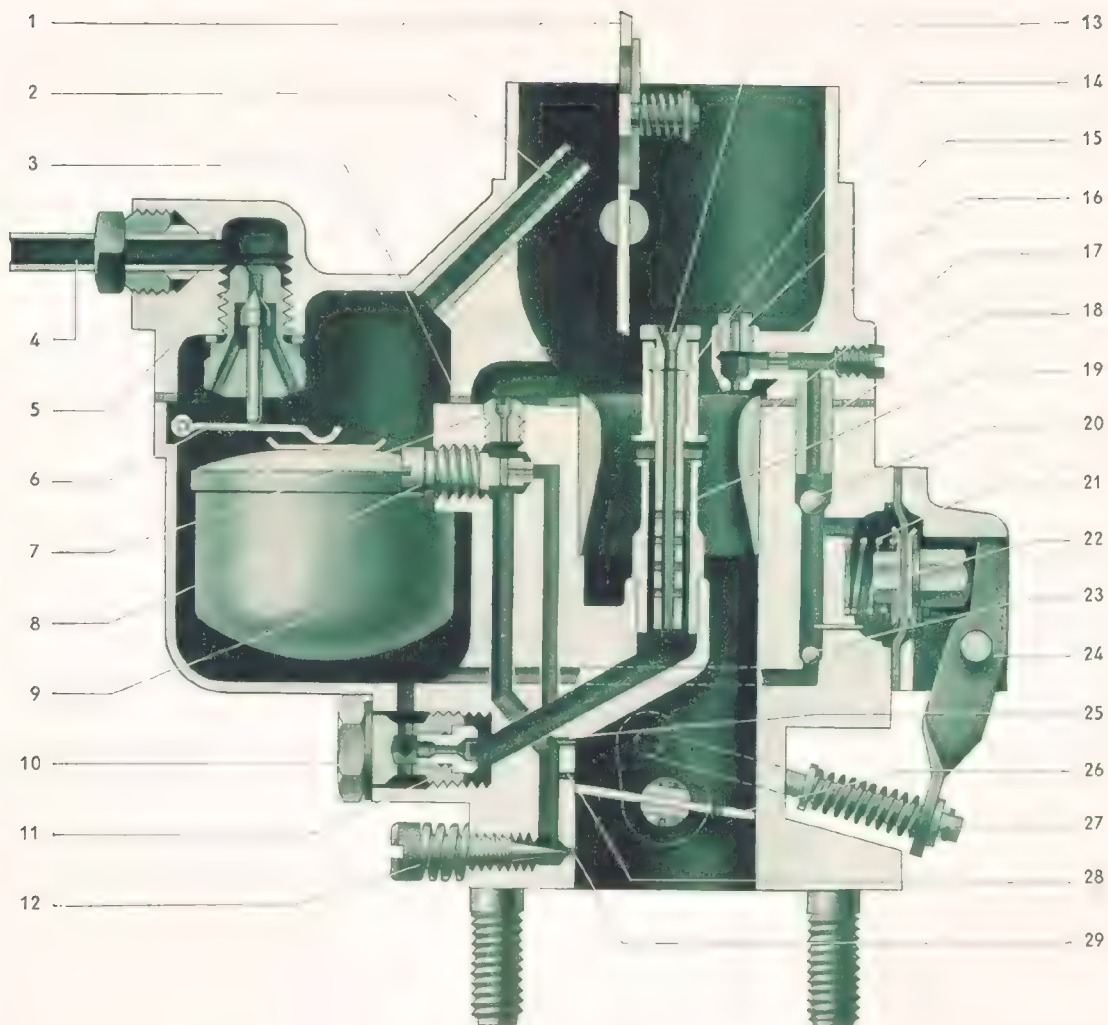
The carburetor consists of the bowl (incorporating float, venturi, throttle valve, accelerator pump, and the jet system) and the bowl cover (incorporating choke valve, float needle valve, and the pump jets).

## Operation

Fuel is delivered through a line from the fuel pump to the carburetor where it enters the float bowl and the spraying well through the float needle valve. When the fuel level reaches a certain height, the needle valve is closed by the rising float, shutting off the supply of fuel until the fuel level decreases during operation. The pressure of the float buoyancy against the needle valve is increased by the toggle. The float controls the fuel supply by actuating the needle valve in correspondence with the fuel consumption.

During **normal operation** (high speed, part-load circuit), fuel flows from the float bowl through the main jet into the spraying well and is pulled out through a row of radial outlet holes by the vacuum created in the venturi. The amount of the vacuum depends on venturi size, engine speed, and throttle opening. The restriction (waist) of the venturi surrounding the outlet holes in the spraying well speeds up the air drawn in by the engine. Thus the amount of throttle opening determines the force of the vacuum, permitting varying amounts of fuel-air mixture to be pulled from the spraying well. When the throttle opening increases, the fuel level in the spraying well decreases and air is sucked in through the correction jet. This air passes through the holes in the emulsion tube and mixes with the fuel coming from the main jet. Thus, already a foamy mixture passes out through the holes in the spraying well into the venturi, where it meets the main high velocity air current by which it is atomized. The proportion of air increases with the speed. This insures proper proportions of fuel and air required for varying operation conditions.





### SOLEX 28 PCI

- |                          |                                   |  |
|--------------------------|-----------------------------------|--|
| 1 - Choke valve          | 11 - Main jet                     | 21 - Pump diaphragm spring             |
| 2 - Float bowl vent tube | 12 - Volume control screw         | 22 - Pump diaphragm                    |
| 3 - Gasket               | 13 - Air correction jet           | 23 - Pump ball check valve, lower      |
| 4 - Fuel line            | 14 - Emulsion tube                | 24 - Pump connector link               |
| 5 - Float needle valve   | 15 - Pump air correction jet      | 25 - Idle air bleeder passage          |
| 6 - Float toggle         | 16 - Pump jet                     | 26 - Throttle valve                    |
| 7 - Pilot jet air bleed  | 17 - Venturi                      | 27 - Throttle connector rod and spring |
| 8 - Pilot jet            | 18 - Fitting tube                 | 28 - Accelerating port                 |
| 9 - Float                | 19 - Spraying well                | 29 - Idle port                         |
| 10 - Main jet carrier    | 20 - Pump ball check valve, upper |  |

When the throttle is closed, or slightly open, the **idling and low speed circuit** performs the function of furnishing the fuel-air mixture. The air speed is so low and there is such a small volume of air passing through that practically no vacuum develops in the venturi. This means that the spraying well centered in the venturi will not feed any fuel with a closed or slightly open throttle. Therefore, the pilot jet and the pilot jet air bleed produce the mixture at idling speed. This fairly rich mixture is pulled from the idle port by a high vacuum existing on the lower side of the throttle valve. The mixture flows past the tapered point of the volume control screw, mixes with the air escaping around the throttle valve to produce a leaner fuel-air mixture, and passes on into the engine.

The idling mixture is controlled by the volume screw. The idling speed is fixed by the idle adjusting screw.

There are two **accelerating ports** drilled in the wall of the carburetor throat near the throttle valve. When the throttle valve is gradually opened, a nearly constant fuel-air mixture ratio is maintained during the shift from the low-speed to the high-speed circuit. As the edge of the throttle valve swings past the accelerating ports, a sufficient quantity of fuel-air mixture is pulled out by the high velocity air current passing through the space between the edge of the throttle valve and the wall of the carburetor throat.

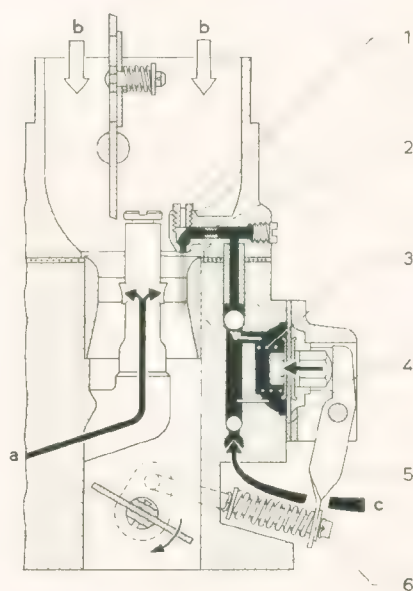
About 10 mm (.4") above the accelerating ports is an idle air bleeder passage which is to lean out the mixture when the throttle valve is suddenly closed. In order to assure a proper function of this bleeder passage, the idling adjustment must be correct.

The accelerator pump is linked to the throttle. When the throttle is closed, the spring-loaded diaphragm returns to its original position and the pump chamber in front of the diaphragm is filled with fuel sucked in from the float bowl. When the throttle valve is opened, the movement is transmitted to the diaphragm through the linkage, forcing the fuel up the passage and out through the discharge nozzle into the mixing chamber. The upper ball check valve is lifted by the fluid pressure while the lower ball check valve prevents the fuel from escaping back into the float bowl. This delivery of additional fuel as the throttle is opened momentarily enriches the mixture and causes the engine to pick up speed quickly. The accelerator pump jet in the discharge nozzle meters the flow of fuel discharged into the mixing chamber. The accelerator pump enriches the mixture only in the low and intermediate speed range, as the spring on the throttle connector rod takes up any further movements of the throttle when the diaphragm has reached its foremost position. The pump chamber is refilled with fuel not before the throttle nearly closes.

### Operation of Accelerator Pump

- a - Fuel from the main jet
- b - Primary air
- c - Fuel from float bowl

- 1 - Pump discharge nozzle and air correction jet
- 2 - Pump jet
- 3 - Diaphragm spring
- 4 - Diaphragm
- 5 - Pump connector link
- 6 - Throttle connector rod and spring



**The high-speed, full power-circuit.** When the throttle is wide open, the accelerator pump passage admits an added flow of fuel to discharge through the pump discharge nozzle. This extra fuel is drawn into the mixing chamber by the suction on the discharge nozzle. At part throttle positions the mixture is only slightly enriched, as the suction is then controlled by the air correction jet in the discharge nozzle. The suction increases with the amount of throttle opening, so that a progressive supply of extra fuel is given to secure added engine performance.

## Adjustment

The carburetor is tested at the factory and adjusted to produce the best consumption-to-performance ratio. Any change in its setting by replacing the jets or the venturi by other than the prescribed sizes should be avoided. In general, excessive fuel consumption is not due to any malfunctioning of the carburetor. With the idling mixture being overrich, the engine tends to stall when suddenly braking and the consumption will be excessively high in the speed range up to 60 km/h (40 m.p.h.). A properly adjusted idling speed is the first requirement for a perfect functioning of the carburetor. The idling adjustment should be carried out with the engine having obtained operating temperature.



## Cleaning the Carburetor

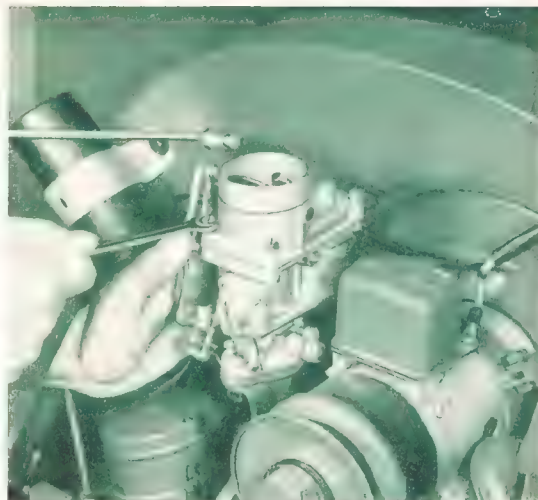
To clean the carburetor, remove the bowl cover.

### Removal

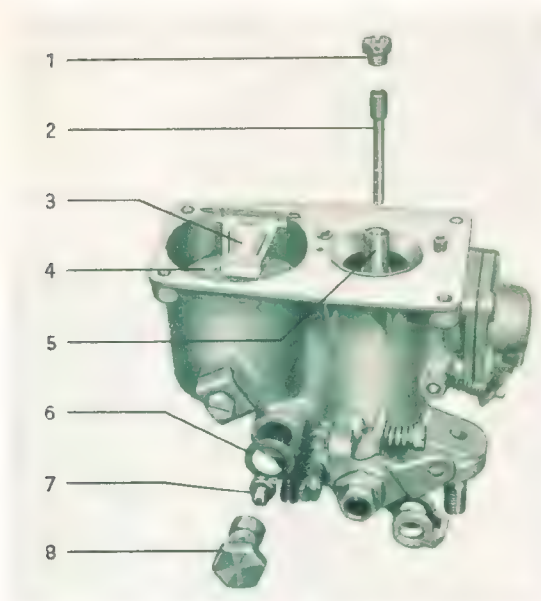
- 1 - Remove air cleaner.
- 2 - Disconnect fuel line between carburetor and fuel pump.
- 3 - Remove the screws that attach the cover to the carburetor bowl.
- 4 - Lift the bowl cover.
- 5 - Swing the bowl cover backward. For the complete removal of the bowl cover, the choke control cable and the throttle connector link must be disconnected.

### Cleaning

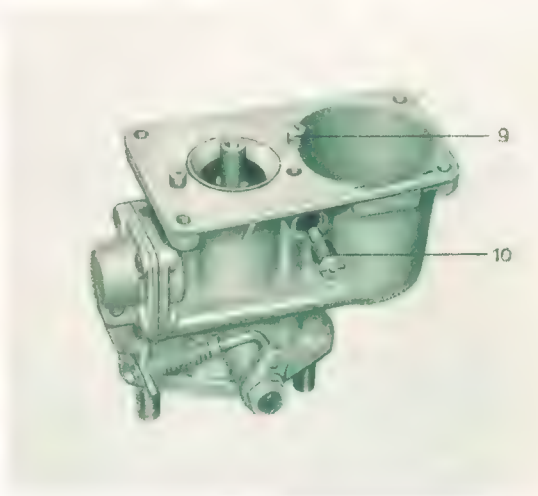
- 1 - Remove float toggle lever.
- 2 - Remove float.
- 3 - Remove main jet carrier and clean float bowl and main jet.
- 4 - Remove and clean air correction jet and emulsion tube (The spraying well is not removable).



- 5 - Remove and clean pilot jet.
- 6 - Remove and clean pilot jet air bleed.



- 1 - Air correction jet
- 2 - Emulsion tube
- 3 - Float toggle lever
- 4 - Float
- 5 - Spraying well
- 6 - Gasket
- 7 - Main jet
- 8 - Main jet carrier



- 9 - Pilot jet air bleed
- 10 - Pilot jet

- 7 - Remove and clean float needle valve.
- 8 - Clean pump discharge nozzle.

Blow out the jets and passages with compressed air. Never use a pin or a piece of wire, as this will damage the jets.

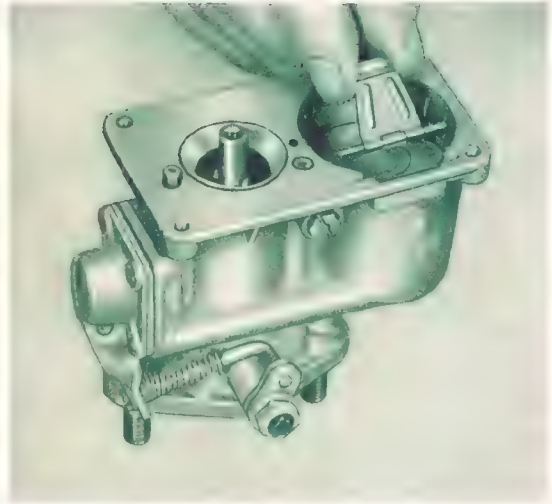
### Installation

To reinstall the unit, proceed in reverse order, while observing the following points:

- 1 - Note proper position of float needle valve gasket.



- 2 - Be sure the gasket between bowl and bowl cover is in good condition and properly positioned.
- 3 - The word "oben" on the float toggle lever must face upwards.
- 4 - When refitting the bowl cover, take care that the fitting tube projecting from the jointing



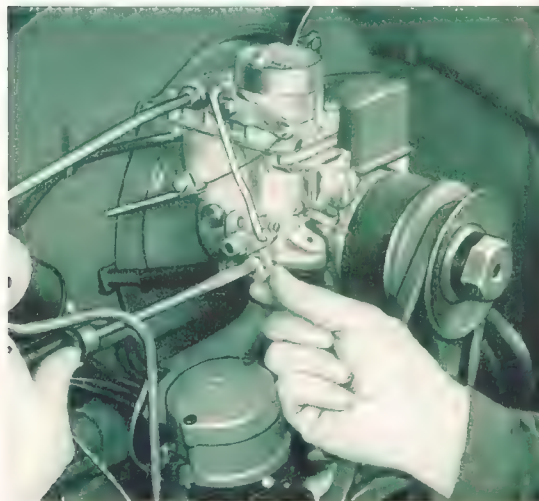
face of the carburetor bowl fits snugly into the bowl cover.

- 5 - Connect choke control cable, taking care that the choke valve is fully open with the operating knob pushed in.
- 6 - Oil choke valve shaft, throttle valve shaft and control linkage.
- 7 - Do not overtighten air cleaner clamp screw to avoid distortion of the air horn, as this would cause the choke valve to stick.
- 8 - Adjust idle speed.

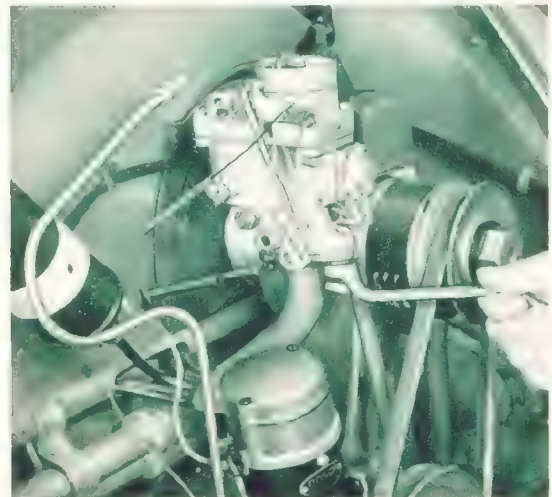
## Removing and Installing Carburetor

### Removal

- 1 - Remove air cleaner.
- 2 - Disconnect fuel line between carburetor and fuel pump.
- 3 - Disconnect accelerator cable, choke control cable, and choke control cable sleeve.



- 4 - Remove accelerator cable swivel pin.
- 5 - Unscrew nuts of carburetor mounting studs (Cranked Ring Spanner VW 158).



- 6 - Take off carburetor.

### Installation

Installation is a reversal of the preceding operations, but the following points should be noted:

- 1 - Replace gasket at intake manifold flange.
- 2 - To connect accelerator cable to throttle lever proceed as follows: Open throttle valve so that there is a clearance of about 1 mm (.04") between throttle lever and stop at carburetor

body. Fully depress accelerator pedal and connect cable to throttle lever.

- 3 - Connect choke control cable, taking care that the choke valve is fully open with the operating knob pushed in.
- 4 - Do not overtighten clamp screw of air cleaner.
- 5 - Adjust idle speed.

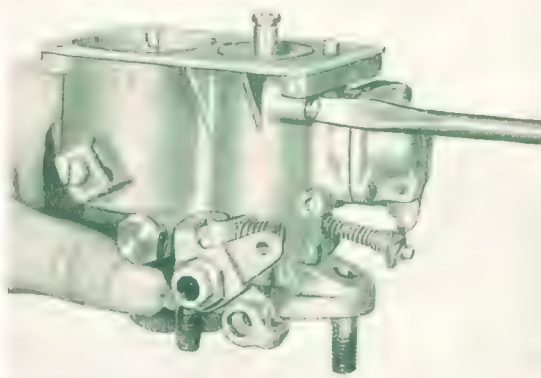
## Disassembly and Assembly of Carburetor

### Disassembly

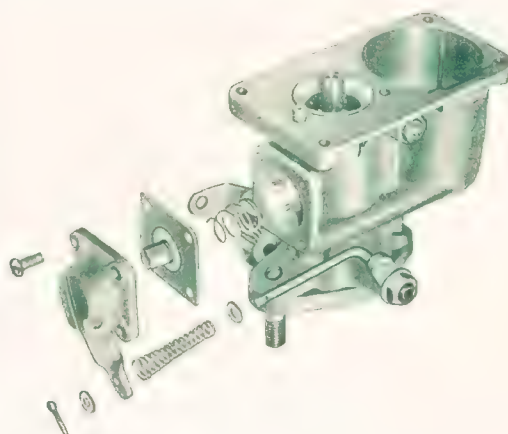
- 1 - Remove carburetor.
- 2 - Remove the screws that attach the cover to the carburetor bowl and lift off the cover.
- 3 - Screw out float needle valve.
- 4 - Remove float toggle lever and take off the float.
- 5 - Remove air correction jet and emulsion tube.
- 6 - Remove main jet, pilot jet, and pilot jet air bleed.
- 7 - Remove volume control screw and spring.



- 8 - Release venturi retaining screw and lift out venturi.



- 9 - Remove cotter pin from throttle connector rod.
- 10 - Remove pump cover retaining screws. Take off cover, diaphragm, and spring.



- 11 - Screw out discharge nozzle plug screw.



## Cleaning

- 1 - Clean all carburetor components in fuel.
- 2 - Blow out the jets, valves and passages with compressed air. Never use a pin or a piece of wire, as this will damage the jets.

## Inspection and Assembly

Assembly is a reversal of the disassembly procedure. To check the components, proceed as follows:

### Bowl Cover

- 1 - Check needle valve for leaks.
- 2 - Examine needle valve gasket for correct condition and see to it that it is properly installed to prevent leaks.
- 3 - Check choke valve spring and clearance of choke valve shaft.
- 4 - Inspect choke poppet valve for perfect sealing and make sure that it easily opens.

#### Note: Carburetor SOLEX 28 PCI

From Chassis No. 1 306 289 the tension of the choke poppet valve spring has been increased from 33 grams (1.16 oz.) to 48±7 grams (1.69±.25 oz.) at a loaded length of 8 mm (.314"), the free length being about 21 mm (.827").

The stronger spring can be installed on all earlier carburetors 28 PCI.

The object of these modifications is to facilitate starting the engine in severe frost.

### Carburetor Bowl

- 1 - Check pump diaphragm for leaks. Replace if necessary.

#### Note:

Carburetor "flat spot" when suddenly opening the throttle generally indicates a leaky pump diaphragm.

- 2 - Dip float in hot water. If air bubbles appear, the float is leaky and must be replaced. Leaky floats must not be soldered, as this would result in an increase of the weight. (See "Specification Data" for correct weight of float.)

#### Note:

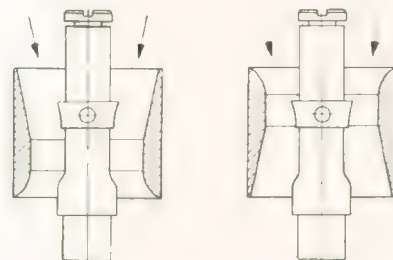
From Engine No. 1-0814 685 the carburetor 28 PCI is equipped with a nylon float (weight 5.7 grams).

Brass and nylon floats are interchangeable. Brass floats still in stock should be used up.

- 3 - Check all jets for the correct sizes given in the chart "Specification Data".

When replacing jets or valves, only genuine SOLEX parts should be used. Only these parts assure a perfect functioning of the carburetor under all conditions of operation. Only use main jets and main jet carriers provided with ring grooves.

- 4 - Install venturi. Be sure that the restriction of the inner diameter (waist) of the venturi is at the top.



**Wrong!**

**Correct!**

Do not overtighten retaining screw in order not to distort venturi.

#### Note:

The carburetor is now fitted with a plastic venturi instead of the previous light metal type.

Venturies of the earlier and of the new type are interchangeable.

- 5 - Check clearance of throttle valve shaft. Excessive clearance causes ingress of secondary air which has a detrimental effect on the starting and idling operation of the engine. If necessary, fit bushes to throttle valve shaft to take up the clearance.
- 6 - Inspect tip of volume control screw. Renew if tip is bent or broken off. Only use volume control screws of brass.  
  
Inspect tapped hole and seat for volume control screw for damage; remove tip of old control screw, if it has broken off.
- 7 - The word "oben" on the float toggle lever must face upwards.

## Carburetor Adjustment

The jet settings have been determined by the manufacturer after considerable research to assure the best consumption-to-performance ratio. Any change in the settings by replacing the jets or the venturi by other than the prescribed sizes should be avoided. When changing from one brand of fuel to another, say from gasoline to a gasoline/benzol mixture, the carburetor requires in general only a readjustment of the idling speed.

### Specification Data

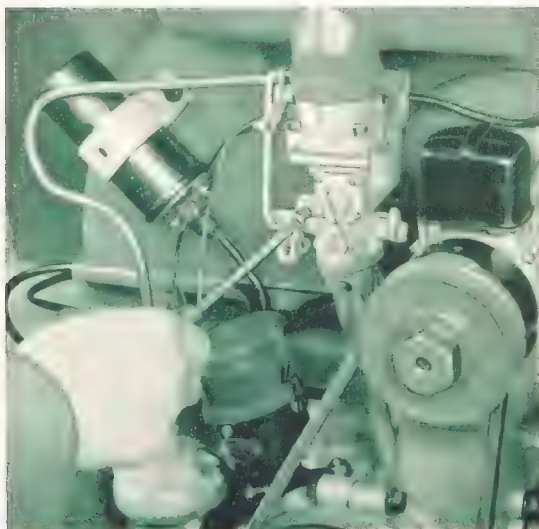
	1131 c.c. engine	1192 c.c. engine
Venturi .....	20 mm diam.	21.5 mm diam.
Main Jet .....	105	122.5
Pilot Jet .....	50	50
Pilot Jet Air Bleed .....	0.8 mm diam.	0.8 mm diam.
Air Correction Jet .....	190	200
Pump Jet .....	50	50
Pump Air Correction Jet .....	2.0	2.0
Emulsion Tube .....	10	29
Needle Valve .....	1.5	1.5
Float Weight .....	12.5 g	12.5 g
Pump Feed .....	.40—.55 c.c. per stroke	.40—.55 c.c. per stroke

### Idling Adjustment

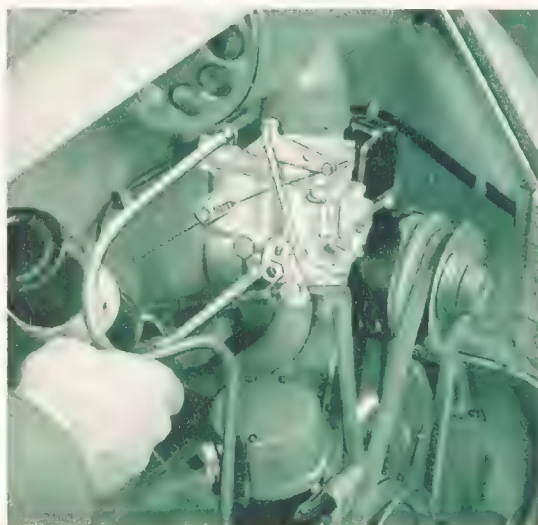
An idling adjustment will be necessary from time to time. **Before attempting to adjust the carburetor, make sure the engine is at normal operating temperature.**

Idling adjustment should in all events be carried out as follows:

- 1 - Turn the idling adjusting screw in or out until an idling speed of approximately 550 r.p.m. has been attained.



- 2 - Turn the volume control screw clockwise until the engine speed begins to drop, then give it a quarter turn in anti-clockwise direction. Then, if necessary, adjust a little in either direction until the engine idles smoothly.



- 3 - Re-adjust the idling adjusting screw until the engine runs at normal idling speed.

Normal idling speed is usually attained at  $1\frac{1}{4}$  to  $1\frac{1}{2}$  turns of the volume control screw, starting from the fully closed position.

However, do not attempt to close the screw completely as any improper handling will tend to damage the conical tip or the idle port.

Accurate idling adjustment is of the greatest importance as it has an essential bearing on fuel consumption in the lower and medium speed ranges. Under really unfavorable conditions, the increase in consumption may even reach  $\frac{1}{2}$  liter for each hundred kilometers (1 Imp. gall. for each 560 miles, or 1 U.S. gall. for each 470 miles). It

will be especially pronounced in the case of vehicles operating under unfavorable conditions most of the time.

Check by speeding up the engine momentarily and releasing the accelerator pedal quickly. If the engine stalls, the mixture should be enriched a trifle by backing out the volume control screw (approx.  $\frac{1}{16}$  turn) until sudden releasing of the pedal after acceleration does not cause stalling. If no remedy is effected, it may be due to a worn carbon thrust

ring of the release bearing. During operation a stalling of the engine when the throttle is suddenly shut or when applying the brakes may also be caused by too rich a mixture. Poor idling may be the result of damaged gaskets, or intake manifold flanges not sufficiently tightened, or fuel pump being mal-adjusted.

Faults in the ignition system or an undue departure from the correct compression in the individual cylinders may also have a detrimental effect on the idling.

## Air Cleaner

### General

The purpose of the air cleaner is to filter all dust and grit from the air drawn through the carburetor intake, thus eliminating one of the contributory causes of cylinder and piston wear. The air cleaner must be serviced at the intervals indicated in the Maintenance Chart, or more frequently under severe dust conditions.

If the car is mainly operating under desert or other extreme conditions of dust-laden atmosphere, the air cleaner should be serviced more frequently than prescribed on the Maintenance Chart. The air cleaner must at any rate be cleaned if there is no longer thin oil above the sludge accumulated on the bottom of the oil reservoir.

### Felt Cone Type Air Cleaner

This filter cannot be dismantled. Rinse the air cleaner in fuel or another volatile cleaner. The fuel is to be poured into the intake hole of the filter. The cleaner should be blown dry before replacing it in order to avoid starting trouble.

### Oil Bath Air Cleaner

should be serviced every 5000 km (3000 miles). Detach cleaner from carburetor, unfasten retaining strap and disassemble the cleaner. Remove dirty oil from reservoir and refill with fresh engine oil SAE 20 up to the mark (approx. 0.25 liter/0.5 pint). The filter element should be rinsed in fuel, kerosene, or any other degreasing solution.

The oil level in the fluid reservoir should be checked every 2500 km (1500 miles). When topping up, take care that the oil level is not above the mark.



- 1 - Filter element
- 2 - Gasket
- 3 - Oil reservoir

### Note:

The shape of the oil bath air cleaner has been altered.

While the outer diameter has been decreased, the total height has been increased.

The designation for the new cleaner is:

Oil Bath Air Cleaner Part No. 111 129 611 D } (as  
Oil Bath Air Cleaner Part No. 111 129 611 E } desired)

Service installation of the new oil bath air cleaner in vehicles of previous design is possible. The previous oil bath air cleaner may, however, not be installed in vehicles of later version.

The oil level must not be above the mark pressed in the lower part.

This alteration was necessary because of the new shape of the engine compartment hood.

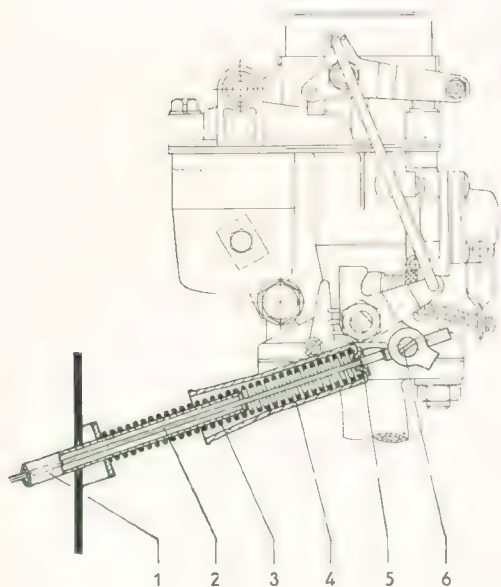


## Removing and Installing Accelerator Cable

### General

The accelerator cable passes through the frame tunnel and fan housing of the engine in conduit tubes. It is attached to a bolt in the accelerator pedal at one end and to a swivel pin in the throttle valve lever at the other.

The spring pushed over the conduit tube at the fan housing effects a return of the accelerator cable and closes the choke. A guide sleeve prevents the spring from becoming deflected.



- 1 - Accelerator cable conduit tube
- 2 - Accelerator cable
- 3 - Accelerator cable spring
- 4 - Spring guide sleeve
- 5 - Spring seat
- 6 - Accelerator cable swivel pin

### Removal

The removal and installation is facilitated by lifting the rear end of the vehicle.

- 1 - Disconnect accelerator cable from throttle valve lever.
- 2 - Compress the spring and remove spring seat. Take off guide sleeve and spring.

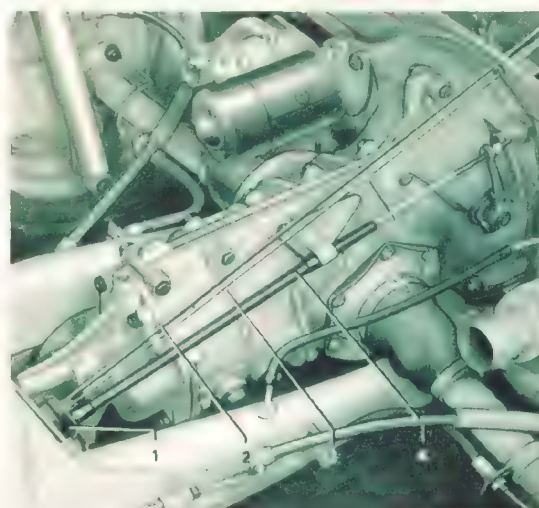


- 3 - Detach bolt from accelerator pedal and disconnect cable from bolt.
- 4 - Pull out accelerator cable from its conduit tube in the fan housing towards the front.
- 5 - Take off rubber boot at the end of the cable conduit tubes in the frame.
- 6 - Completely pull out accelerator cable towards the front.

### Installation

This is a reversal of the preceding operations, but the following points should be noted:

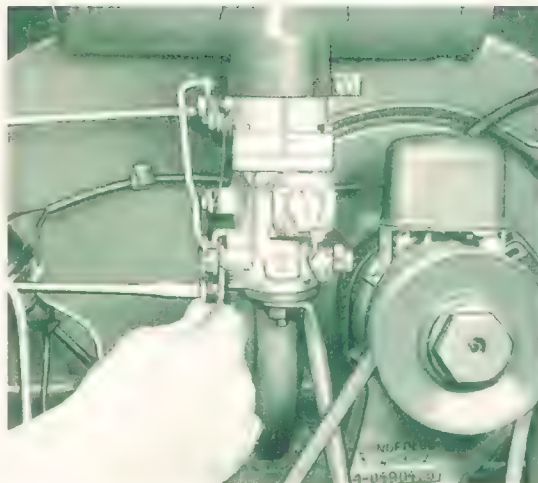
- 1 - Grease accelerator cable with Universal Grease VW - A 052.
- 2 - Take care that the cables do not intertwine at the rear.



- 1 - Rubber boot
- 2 - Choke control cable
- 3 - Accelerator cable
- 4 - Clutch cable

3 - See that the rubber boot is correctly seated to avoid water entering the conduit tubes.

4 - Special care must be taken when attaching the accelerator cable to the throttle valve lever, as otherwise an undue tension may occur at full throttle, leading to a breakage of the cable. Open throttle valve so that there is a clearance of about 1 mm (.04") between throttle lever and stop at carburetor body. Fully depress accelerator pedal and connect cable to throttle valve.



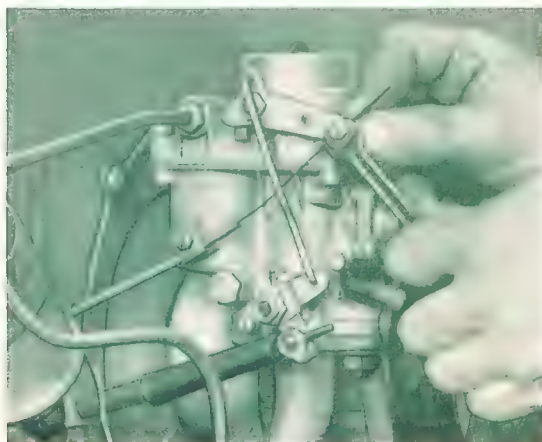
## Removing and Installing Choke Control Cable

### General

The choke control cable runs through a flexible metal sleeve which in turn is provided with a plastic coating. It passes from the instrument panel through the front luggage compartment and cross scuttle to the conduit tube in the frame tunnel, from where it passes to the carburetor through the fan housing. The cable is attached to the choke lever by means of a clamp screw. The choke valve is operated by pulling the knob situated next to the ignition switch.

### Removal

- 1 - Lift the car.
- 2 - Disconnect cable from choke lever and detach cable sleeve from carburetor.



3 - Screw off operating knob from instrument panel.

4 - Remove the lining in front of the instrument panel. Remove nut from the back side of the instrument panel and pull out choke control cable.



5 - Remove right-hand front wheel. Detach choke control cable rubber sleeve from conduit tube protruding from the frame tunnel and pull out cable and flexible metal sleeve.



### Installation

Installation is accomplished by reversing the removal procedure, but the following points should be observed:

- 1 - Take off rubber boot at the rear end of the conduit tubes in frame tunnel and fill it with Universal Grease VW - A 052.
- 2 - Blow out conduit tube in frame tunnel with compressed air and fill it with Universal Grease VW - A 052.
- 3 - Grease choke control cable with Universal Grease VW - A 052 and insert it into the flexible metal sleeve.
- 4 - Push cable and sleeve from front luggage compartment through the cross scuttle into the frame tunnel conduit tube. To avoid ingress of water, make sure that the rubber grommet in the cross scuttle, the rubber sleeve on the conduit tube front end, and the boot at the conduit tube end are correctly positioned.
- 5 - Take care that the choke cable does not intertwine with the clutch or accelerator cable.
- 6 - Attach choke control cable to the instrument panel and screw the knob in position.
- 7 - Attach choke control cable to choke lever taking care that the choke valve is fully open with the operating knob pushed in.

## Operation of Choke Valve

It is a known fact that the choke valve is to be operated i. e. the choke control knob is to be pulled out when starting a cold engine at low outside temperature.

As soon as the engine has started, push the choke control knob slowly in until the engine runs smoothly and evenly at idling speed without stalling even when declutching. How far the knob should be pushed in is a matter of experience but in any case it has to be pushed in farther at mild temperature than at severe cold.

The choke control knob is to be pushed in completely only after a certain distance has been driven. The required length of this distance depends on the outside air temperature and on the way of driving. The linkage between choke valve and throttle valve causes the throttle to open a little when the choke valve closes. As a result, the idling speed of the engine can be regulated over a wide range so that the engine can be prevented from stalling on account of low operating temperature.

Quite frequently, the choke control knob is pushed in all the way immediately after starting and the driver may then be surprised to notice that the engine stalls at the next stop. And now, the wrong kind of counter-measure is usually taken against this sort of stalling: idling speed is increased by means of the idle adjusting screw and the idling mixture is enriched by means of the volume control screw. Apart from the fact that the engine, when warming up, will then run at too fast an idling speed with too rich a mixture, the fuel consumption may be increased by  $\frac{1}{2}$  liter per 100 km (almost a quart for every 60 miles). Furthermore, with this kind of adjustment, the engine will occasionally tend to develop combustion knock.

It is not always the customer who, for lack of knowledge and experience, changes the idling adjustment arbitrarily. May we, therefore, suggest that the workshop personnel be thoroughly instructed about the proper idling adjustment and about how to operate the choke control knob correctly.



## Carburetor Trouble Checking

Symptoms	Cause	Remedy
1 - Engine will not start (with fuel in tank, ignition in order, and choke closed)	<p>a - Choke does not fully close</p> <p>b - Choke poppet valve sticks or does not fully close</p> <p>c - No fuel in system</p>	<p>a - Eliminate jamming, replace choke if necessary. Do not overtighten air cleaner clamping screw</p> <p>b - Repair or replace choke poppet valve</p> <p>c - Check in the following order: Release main jet carrier. If fuel is coming out, the main jet is obstructed. If no fuel is coming out, disconnect pipe to fuel pump and set starter in motion with the spark plug leads disconnected. If there is a well-defined spurt of fuel at every working stroke of the pump, the float needle valve is clogged up. If no fuel is ejected, it may be due to: pump valves sticking, pump mechanism at fault, dirt in fuel tap</p>
2 - Flat spot at idling speed	<p>a - Pilot jet blocked up</p> <p>b - Induction air leakage at flange. Cracks in induction manifold</p> <p>c - Volume control screw damaged (tip broken off)</p> <p>d - Idling mixture too lean</p>	<p>a - Clean pilot jet</p> <p>b - Tighten induction manifold flanges, replace gasket if necessary. Check induction manifold for air leakage. Weld or renew cracked induction manifolds</p> <p>c - Replace volume control screw (remove tip, if broken off)</p> <p>d - Properly adjust idle mixture and idle speed so that engine runs evenly and steadily</p>
3 - Poor acceleration	<p>a - Idling mixture too lean</p> <p>b - Accelerator pump diaphragm leaky</p>	<p>a - Properly adjust idle mixture and idle speed so that engine runs evenly and steadily</p> <p>b - Check and, if necessary, replace diaphragm</p>

Symptoms	Cause	Remedy
4 - Engine stalls when suddenly releasing accelerator pedal	Idle mixture too rich	Check and correct idle adjustment
5 - Engine runs uneven at low idle speed and exhaust soots excessively at high idle speed. Spark plugs tend to soot up and fail to produce sparks	a - Excess pressure on float needle valve b - Float leaky c - Float needle valve does not close	a - Check pump pressure, reduce if necessary b - Replace float c - Clean or replace float needle valve
6 - Engine runs uneven, misfires, and cuts out at full throttle	Fuel starvation	a - Clean main jet b - Clean float needle valve c - Check pump pressure, increase if necessary d - Clean fuel tap
7 - Excess fuel consumption	a - Jet sizes not properly adapted to one another b - Excess pressure on float needle valve c - Float leaky d - Float needle valve does not close	a - Install correct set of jets. Check "face" of spark plugs b - Check pump pressure, reduce if necessary c - Replace float d - Check float needle valve and replace if necessary

**Note.** Poor acceleration and a tendency of the engine to stall when idling may also be due to an insufficiently advanced ignition, too low a breaker point gap, or dirty spark plugs. Always check ignition system when in doubt.

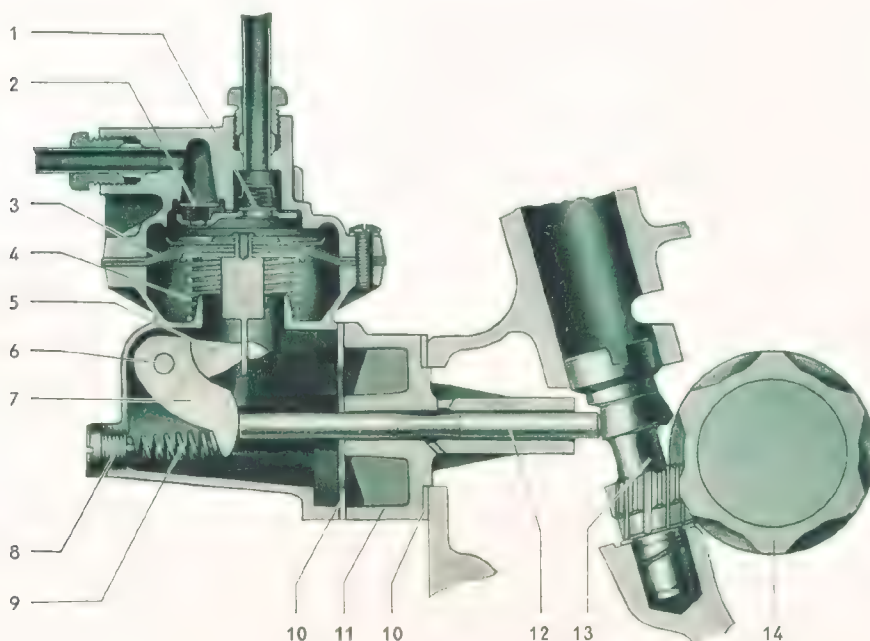
## General Description

Fuel is fed to the carburetor by a SOLEX-diaphragm pump which is attached to the crankcase. It is operated mechanically from an eccentric on the distributor drive shaft. The flow of fuel delivered by the pump is automatically regulated as the fuel is used up from the float bowl.

The fuel pump consists of the cover, containing suction valve and delivery valve, and the pump body, incorporating the rocker mechanism. The diaphragm and spring are situated between the cover and the body. The diaphragm consists of several layers of special flexible, clothlike material that is not affected by the fuel and two protectors which are riveted to the diaphragm pull rod.

## Operation

As the distributor drive shaft revolves, the eccentric causes the push rod to move against the rocker arm which pulls the diaphragm downward against the diaphragm spring. This movement creates a vacuum above the diaphragm which lifts the suction valve off its seat so that fuel can be drawn in. When the push rod moves backwards, the loaded diaphragm spring pushes the diaphragm upward, forcing the fuel in the pump through the delivery valve and into the carburetor. This process is repeated at every turn of the eccentric (once every two revolutions of the engine).



**SOLEX Fuel Pump Sectional View**

- |                      |                                      |
|----------------------|--------------------------------------|
| 1 - Delivery valve   | 8 - Spring retaining plug and gasket |
| 2 - Suction valve    | 9 - Rocker arm spring                |
| 3 - Diaphragm        | 10 - Gasket                          |
| 4 - Diaphragm spring | 11 - Intermediate flange             |
| 5 - Rocker arm link  | 12 - Push rod                        |
| 6 - Rocker arm pin   | 13 - Distributor drive shaft         |
| 7 - Rocker arm       | 14 - Distributor drive gear          |



The pump pressure depends on how much the spring is compressed during the pump suction stroke. This pressure is balanced by the buoyancy of the carburetor float, which causes a corresponding pressure at the needle valve seat. As fuel rises in the float bowl, the needle is forced up with greater pressure. Thus the pressure in the fuel line and pump chamber increases, while the pump working stroke decreases. With normal engine operation, the diaphragm is moved only some tenth of a millimeter.

A hole is provided for bleeding the chamber below the diaphragm. This hole also permits the draining of fuel which might have entered the lower chamber.

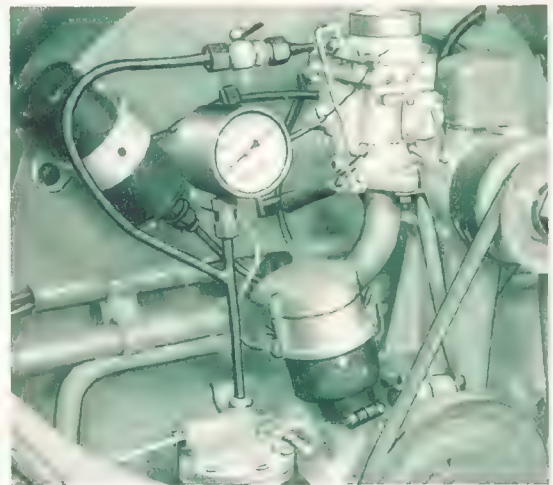
## Checking Pump Pressure

The pump pressure should amount to 0.09—0.13 atm. (1.30—1.85 lbs./sq. in.) with the needle valve closed and the engine running at 1000—3000 r.p.m. The minimum amount of fuel delivery is 167 cu. cm per minute (10.2 cu. ins.). To check the fuel pump pressure, connect a manometer (range: 0—0.4 atm. = 0—5.7 lbs./sq. in.) which is brazed to a fuel test line between the pump and the carburetor by means of a T-piece. The fuel test line is fitted with a fuel tap behind the manometer (drawing VW 364 for local manufacture).

The pump pressure is determined by the correct adjustment of the push rod stroke and the diaphragm spring tension.

Adjustment of the push rod stroke is effected by adding or removing flange gaskets as described under the heading "Removing and Installing Fuel Pump".

If the stroke adjustment does not give the desired result, replace the diaphragm spring. With the pump pressure too high, the intermediate turns of the spring may be brought further together, and with the pump pressure too low they may be stretched apart, if the necessity should arise.



If the pressure is too high, flooding and, consequently, a dilution of the engine oil will be the result.

If it is too low, insufficient fuel will be delivered and faulty engine performance will result.

## Removing and Installing Fuel Pump

### Removal

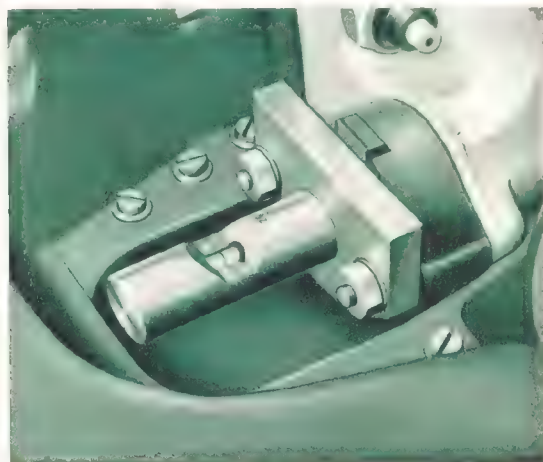
- 1 - Disconnect fuel lines from pump.
- 2 - Remove the two nuts from the mounting studs at the flange (Spanner VW 126a).



- 3 - Take off pump.
- 4 - Remove push rod, intermediate flange and gasket.

### Adjusting Stroke of Fuel Pump

- 1 - Place intermediate flange, push rod and two gaskets, which should be in perfect condition, on fuel pump mounting studs. The oil passage in the intermediate flange must face upwards. The convex end of the push rod must be at the eccentric of the distributor drive pinion.
- 2 - Attach Gauge VW 328a to the flange and tighten it to the same torque as for the fuel

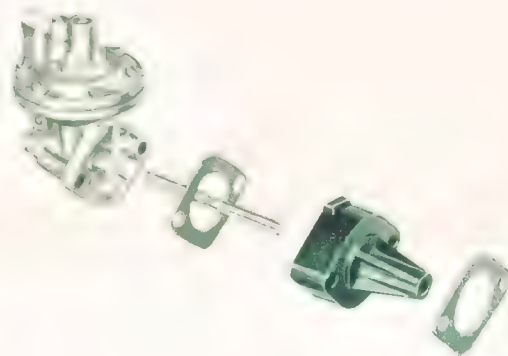


pump in order to compress the gaskets to their usual thickness.

The push rod stroke of about 4 mm (.16") is determined by the eccentric on the distributor drive shaft. The stroke should move within a range of 5 mm (.2") which is marked on the gauge. The marks correspond to a length of 29 mm (1.14") and 34 mm (1.34") measured from the fuel pump contact flange (incl. gaskets) to the projecting push rod end. Rotate the engine to check the pump stroke. The stroke can be adjusted by fitting an appropriate number of gaskets to the intermediate flange. Do not fit less gaskets than required, as this would have a detrimental effect on the diaphragm and the drive mechanism.

### Installation

- 1 - Fill lower pump chamber with Universal Grease VW - A 052 before installation.



- 2 - Install fuel pump. Re-tighten nuts with engine having attained working temperature, but do not overtighten.
- 3 - Connect fuel lines to fuel pump.

See that the fuel line rubber grommet is correctly seated in the engine front cover plate.

## Reconditioning Fuel Pump

### Disassembly

- 1 - Remove fuel pump.
- 2 - Unscrew the six slotted screws and remove pump cover.
- 3 - Press down diaphragm and disconnect it from rocker arm link.



- 4 - Drive out rocker arm pin. Remove rocker arm link and rocker arm and retaining plug with gasket and spring.
- 5 - Remove valve retainer plate from fuel pump cover by pressing down the plate until the three screws have been screwed out. Carefully lift off the plate to avoid the components jumping off.



- 6 - Thoroughly clean all parts in fuel.

### Assembly

- 1 - Inspect valve seats in pump cover and at valve retainer plate. Replace worn parts.
- 2 - Renew valves, valve springs and valve retainer plate gasket. Place valves in position, taking care that their lapped side makes contact with the valve seat.



- 3 - Place valve retainer plate in position and press it down until the three screws are evenly tightened.
- 4 - When the valves are installed, make certain that they open and seal properly.
- 5 - Assemble rocker arm and link in the pump body. Check rocker arm pin for wear. Install pin and secure it in position by means of a chisel.

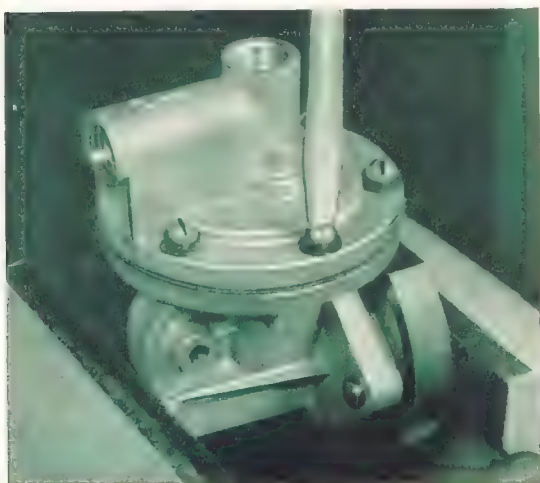


- 6 - Assemble rocker arm spring, retaining plug and gasket.



7 - Place spring and diaphragm in position. Engage the diaphragm pull rod in the rocker arm link. Replace diaphragm if showing signs of cracks or hardening.

8 - Place fuel pump body in a vise with the Gauge VW 328b inserted. Thus the rocker arm is pressed 35 mm (1.4") inwards (measured from flange jointing face), bringing the diaphragm to the required assembling position.



9 - Place the pump cover in position, taking care that the diaphragm is not creased up. Securely tighten cover screws diagonally.

10 - Fill lower pump chamber with Universal Grease VW - A 052 (anti-freeze). The grease assumes a liquid condition at operating temperature, ensuring a proper lubrication of all moving parts. The lubrication is improved by the engine oil which is fed into the pump chamber through the push rod bore in the fiber flange, rendering another grease packing unnecessary. Rocker arms and push rods which are devoid of grease or oil indicate a leaky diaphragm.

**Note.** - Only use genuine SOLEX Spare Parts to assure a perfect functioning of the fuel system under all conditions of operation.

## Fuel Pump Trouble Checking

Symptoms	Cause	Remedy
1 - Pump leaky at jointing faces: Loss of fuel	a - Slotted screws insecure b - Diaphragm cracked	a - Tighten screws b - Renew diaphragm (VW 328 b)
2 - Diaphragm leaks at rivets: Loss of fuel	Diaphragm damaged by unskilled assembly	Renew diaphragm (VW 328 b)
3 - Diaphragm material leaky: Loss of fuel	Diaphragm material damaged by solvent substance in fuel	Renew diaphragm (VW 328 b)
4 - Excessive pump stroke: Overstraining the diaphragm	Pump incorrectly installed, gasket too thin	Correctly install pump (VW 328 a), check diaphragm, if necessary
5 - Pump pressure low	a - Pump incorrectly installed, gasket too thick b - Spring pressure low	a - Correctly install pump (VW 328 a) b - Renew spring or, if necessary stretch it apart
6 - Pump pressure excessive: Float needle valve forced down	a - Pump incorrectly installed, gasket too thin b - Spring pressure excessive	a - Correctly install pump (VW 328 a) b - Renew spring or, if necessary, bring intermediate turns further together
7 - Fuel pump inoperative or insufficient fuel delivery	Valves leaky or sticking	Check valves, renew valves and valve seats, if necessary



# Fuel Tank

# K

The fuel tank, capacity 40 liters (10.5 U.S. gals.; 8.8 Imp. gals.) including a fuel reserve of 5 liters 1.3 U.S. gals.; 1.1 Imp. gals.), is accessible by lifting the front bonnet. The tank is provided with a large filler opening.

## Removing and Installing Fuel Tank

### Removal

- 1 - Close the fuel tap and disconnect fuel hose from fuel pipe.
- 2 - Remove split pin at the end of the fuel tap operating rod, with the r.h. front wheel taken off, and remove operating rod.
- 3 - Unscrew the four tank mounting screws and lift off the tank.



- 4 - Remove fuel tap.
- 5 - Flush tank with fuel and blow it out with compressed air.

### Installation

This is a reversal of the removal procedure, but the following points should be noted:

- 1 - Place fuel tank anti-squeak packing in position; renew packing if damaged.
- 2 - The fuel tap operating rod must neither be tight nor rattle in its guide hole in the body. Note correct seating of grommet. Rods having a tight fit should be installed with the use of French chalk or brake fluid (Caution! Brake fluid has a detrimental effect on the paint).

### Note:

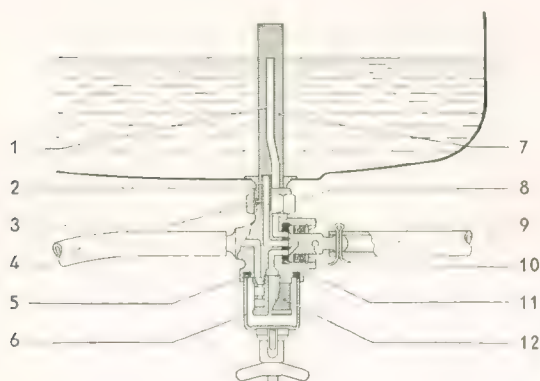
The fuel tank used on cars up to Chassis No. 1 - 0 116 375 is no longer available as a spare part. When new tanks are required, use the latest pattern and modify the body as detailed below:

- 1 - Cut out left and right tank supports, including the angle plates, and weld in the latest pattern supports. Extend the front and rear edges of the tank mounting aperture up to the cowl side panels.
- 2 - Attach fuse box to cowl side panel.
- 3 - Drill hole in center for fuel tap operating rod and plug up the old hole.



## Fuel Tap

Fuel passes through a filter in the tank via the fuel tap and another filter into the fuel line. The tap is operated from the front seat. Its three positions are: A (= open), Z (= shut off), R (= reserve).



- 1 - Drain line with the tap set at "open"
- 2 - Drain line with the tap set at "reserve"
- 3 - Gasket
- 4 - Fuel hose
- 5 - Gasket
- 6 - Filter bowl
- 7 - Filter in tank
- 8 - Fuel tap nut
- 9 - Operating rod
- 10 - Three-way tap
- 11 - Three-way tap gasket
- 12 - Filter

### Cleaning

To remove the filter, loosen the knurled nut or wing nut at the bowl base and remove the bowl. Screw out the filter and clean it. With the tank in situ, the tap is accessible from under the car, or, after one front wheel has been removed, from the side, or through the right-hand inspection hole in the body. The filter should be cleaned in fuel and afterwards dried with compressed air. After assembly, check tap for leaks.



## Removing and Installing Fuel Tap

To clean the fuel tank and the filter in the fuel tank, the tap must be removed.

### Removal

- 1 - Remove and drain fuel tank.
- 2 - Release fuel tap and remove tap.
- 3 - Clean filter with compressed air.

### Installation

This is a reversal of the removal procedure, but the following points should be noted:

- 1 - Thoroughly clean fuel tank.
- 2 - Renew gaskets.
- 3 - After installation, check connections for leaks.

## Reconditioning Fuel Tap

### Disassembly

Two types of fuel tap are used in series production.

#### Type A (with knurled nut)

- 1 - Remove fuel tap.
- 2 - Screw out stop of three-way tap. Release lockscrew for ring screw.



- 3 - Remove three-way tap and rubber seal, using hook spanner for fuel tap.



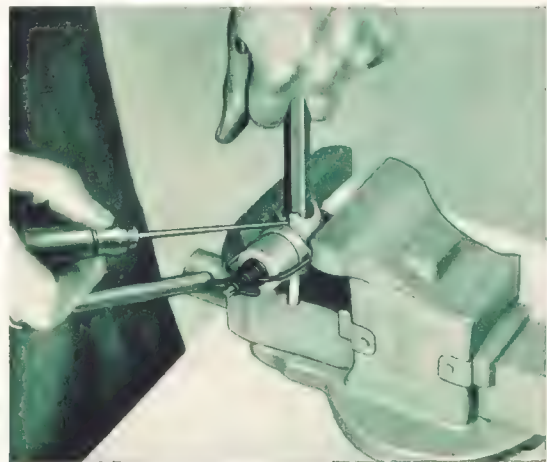
- 4 - Release knurled nut and remove bowl.
- 5 - Unscrew filter retaining screw and remove filter.

#### Type B (with wing nut)

- 1 - Remove fuel tap.
- 2 - Screw out stop of three-way tap.



- 3 - Press down ring cap with a piece of tube and remove circlip.



- 4 - Remove three-way tap and rubber seal.
- 5 - Release wing nut and remove bowl.

- 6 - Unscrew filter retaining screw and remove filter.

### **Assembly**

This is a reversal of the preceding operations, but the following points should be observed:

- 1 - Thoroughly clean all components and dry them with compressed air.
- 2 - Install new rubber parts.

### **Important**

**Only use genuine rubber parts supplied by the factory, as others will be affected by the fuel.**





## Fine Fuel Filter

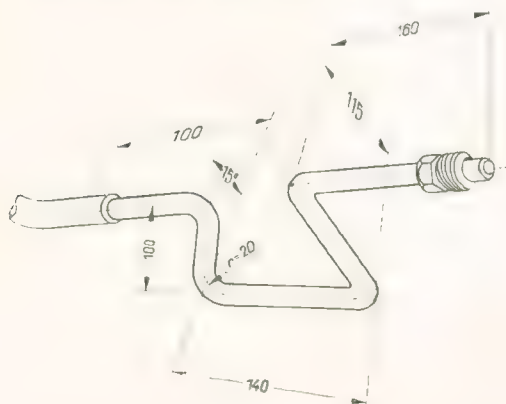
(Optional fitting)

### General

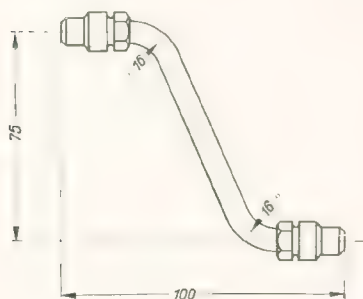
The filter in the fuel tap is generally sufficient to exclude dust and water. An additional filter may be fitted in such cases where fuel is filled into the tank mostly from barrels or cans, when dirt is likely to enter the fuel system. This filter can be obtained as an extra part.

### Installation

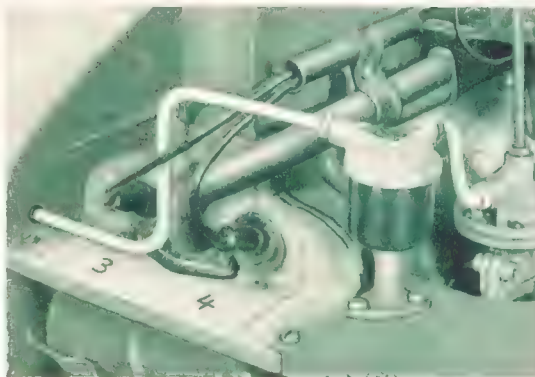
- 1 - Shut off the fuel tap.
- 2 - Disconnect fuel hose from pipe leading to fuel pump (use open end spanner).
- 3 - Remove fuel line to fuel pump.
- 4 - Bend fuel line to fuel filter as shown below.



- 5 - Bend fuel line between filter and fuel pump — as shown below. Only use copper-plated pipes.

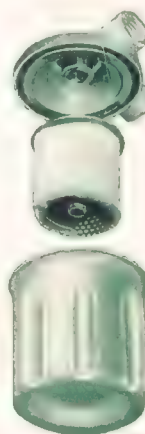


- 6 - Install filter and fuel lines. Connect fuel hose and open the fuel tap.



### Cleaning

- 1 - Unscrew bowl.
- 2 - Remove and wash filter insert. Renew if damaged.



- 3 - Clean filter housing.
- 4 - Assemble filter. Note correct position of gasket.



# Fuel Tank

(From August 1955)

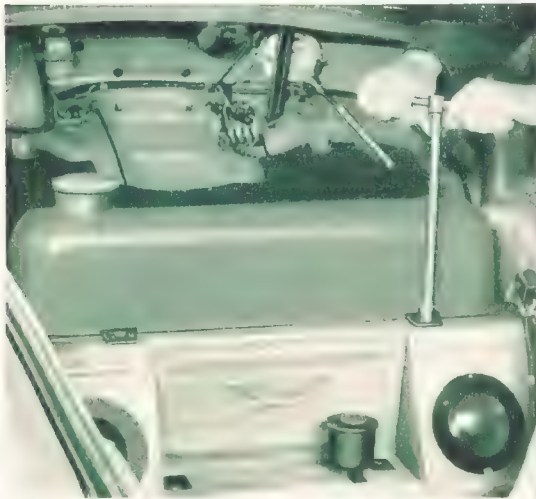
# K

The fuel tank has a capacity of 40 liters (10.5 U.S. gals.; 8.8 Imp. gals.). Access is obtained through the rear-hinged front hood.

## Fuel Tank Removal and Installation

### Removal

- 1 - Lift out spare wheel, jack, and tools.
- 2 - Remove luggage space floor cover.
- 3 - Shut the fuel tap.
- 4 - Remove cotter pin at the end of the fuel tap operating rod, with the r.h. front wheel taken off, and withdraw operating rod.
- 5 - Pull the flexible fuel hose off the fuel tap.
- 6 - Remove the four tank retaining screws and lift off the tank.



- 7 - Remove fuel tap.
- 8 - Flush the tank with fuel and blow it out with compressed air.

### Installation

To install, reverse the preceding operations and observe the following points.

- 1 - Place fuel tank anti-squeak packing in position; renew packing if damaged.

### Note:

From Chassis No. 1 600 440 a 6 mm (.236") thick seal of foam material is installed between fuel tank flange and the luggage compartment floor as a protection against water and dirt. This seal may subsequently be installed on all VW Passenger Cars from Chassis No. 1 - 0 929 746. It is recommended to cement the seal to the underside of the flange prior to installation of the tank, preferably with Universal Glue D 12.

- 2 - The fuel tap operating rod must neither be tight nor rattle in its hole in the body. Note correct seating of grommet. Rods having a tight fit should be installed after applying French chalk or brake fluid (Caution: Brake fluid will affect paint).

### Note:

The fuel tank filler cap serves the dual purpose of providing a seal and compensating any difference in the pressures of the atmosphere and the tank.

If fuel leaks out at the filler cap, proceed as follows to eliminate the source of the trouble:

- 1 - Remove the cap and make sure that the cork gasket is of a thickness of at least 2.3 mm (.09") and sufficiently supple. Renew hard or damaged gaskets. If no new gasket is available, place old gasket for a few minutes in warm water and reinstall it.
- 2 - Check filler orifice edge for evenness (e.g. with a glass plate and a feeler gauge). Permissible unevenness: 0.1 mm (.004"). Greater deviations and damage, which might have been caused in refueling, are not compensated by the cap gasket. In such cases, smooth off the filler orifice edge with a finishing file. Make sure that no metal chips drop into the tank. If necessary, flush out the tank.
- 3 - If no remedy is effected by the above measures, replace the filler cap, as the valve or the sealing in the cap is then likely to be defective.

### Note:

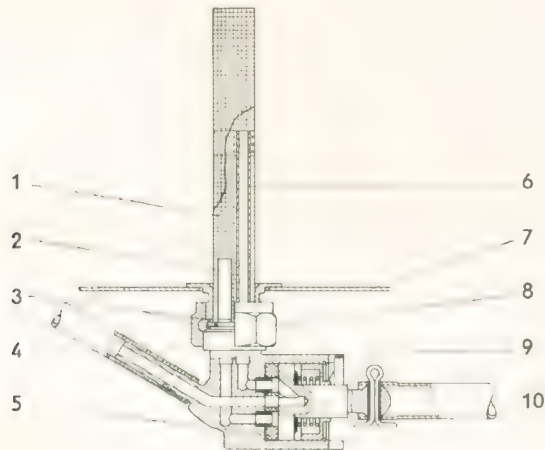
If a proper sealing cannot be effected in workshops, a rubber gasket for sealing the cap to the filler orifice is available as a Service Part.

Part No. 111 201 557 B = 100 mm Ø  
" " 111 201 557 C = 80 mm Ø  
" " 211 201 557 A = 60 mm Ø

The material of this gasket is very supple, assuring a better seal in cases of greater irregularities in the filler contact surface that are difficult to remove.

## Fuel Tap

Fuel passes through a filter in the tank via the fuel tap into the fuel line. The tap is operated from the front seat. Its three positions are: "open", "reserve", and "shut off".



- |  |   |
|--|---|
| 1 - Filter                                   | 6 - Drain line with the tap set at "open" |
| 2 - Drain line with the tap set at "reserve" | 7 - Fuel tank                             |
| 3 - Gasket                                   | 8 - Union nut                             |
| 4 - Fuel line connection                     | 9 - Three-way tap                         |
| 5 - Three-way tap seal                       | 10 - Operating lever                      |

## Fuel Tap Removal and Installation

To clean the filter and the tank, the tap must be removed.

### Removal

- 1 - Remove and drain fuel tank.
- 2 - Use new fuel tap gaskets.
- 2 - Loosen fuel tap nut and take off the tap.
- 3 - Clean filter with compressed air.

### Installation

Reverse the preceding operations and observe the following points:

- 1 - Carefully clean fuel tank.
- 3 - After installation, check connections for tightness.

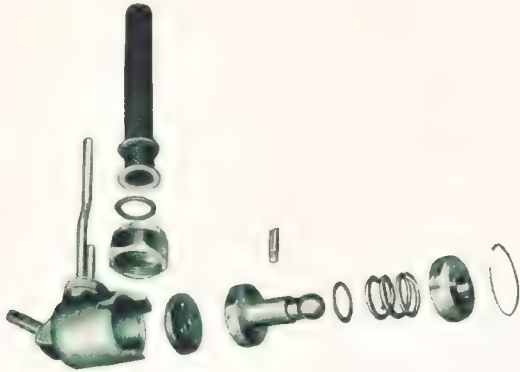
#### Note!

The cork disc between the filter and the long drain pipe should be nearly flush with the upper edge of the pipe.



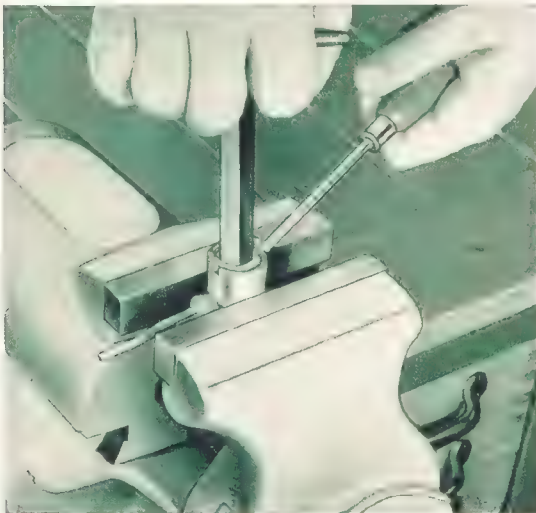
## Reconditioning Fuel Tap

### Disassembly



Remove the fuel tap and proceed in the following order:

- 1 - Screw out stop of three-way tap.
- 2 - Press down ring cap with a piece of tube and remove retaining ring.



- 3 - Remove three-way tap and seal.

### Assembly

This is the reversal of the preceding operations, but the following points should be observed:

- 1 - Thoroughly clean all components and dry them with compressed air.
- 2 - Use new seal.

#### Important

Only use genuine seal supplied by the factory, as others are liable to be affected by fuel.

- 3 - Push the rubber seal over the provided locating tubes.

#### Note:

On cars which have been in service for a prolonged period of time the fuel tap control may become difficult to actuate due to stiffness, and may possibly cause the cotter pin linking the control rod with the tap to shear off. Such stiffness should be overcome as described below:

### Fuel Tap Control

- 1 - Remove, disassemble, and clean fuel tap.
- 2 - Smooth down frictional contact surfaces of three-way tap ring cap and tap housing with extremely fine emery cloth and apply graphite grease prior to assembly. Care should be taken that the grease is evenly and thinly spread with a clean rag.
- 3 - The cotter pin has only a slight clearance in the holes of the control rod and the tap. Make sure that the control rod is in line with the tap stem, as a tilted position of the tap will result in fuel leakage.

**Note:**

From Chassis No. 1 498 843 the gasket between filter and fuel tap has been omitted on approximately 31 000 VW Passenger Cars. A seal is insured by a press fit between

filter and fuel tap housing. The upper gasket between the fuel tank and the filter will be installed as before.

The purpose of this alteration is to do away with leaks at the fuel tap because of an eccentrically positioned gasket.

## Inspection of Fuel System

If the fuel supply to the carburetor is interrupted, check as outlined below.

### Sequence of Operations

- 1 - Check quantity of fuel in tank. The air vent hole in the fuel tank filler cap must not be obstructed.
- 2 - Check position of fuel tap.
- 3 - Disconnect fuel line at the carburetor, leaving a free outlet from the pump. Apply the starter button with the spark plug leads disconnected and check if fuel is delivered by the pump.
  - a - If fuel is delivered by the pump: Check pump pressure. Inspect float needle valve

and carburetor jets for dirt and foreign matter.

- b - If no fuel is delivered by the pump:
- 4 - Disconnect fuel line to fuel pump.
  - a - If fuel is coming out: Check fuel pump for leaks. Retighten screws and connections; remove and check fuel pump, if necessary.
  - b - If no fuel is coming out:
- 5 - Remove fuel tank; check fuel tap; clean filter; inspect gaskets.
- 6 - Connect fuel line to compressed air line.

## Fuel-Mileage Test

### Mileage Test in Car

#### (Average consumption)

An accurate measurement of the fuel consumed can be made with a fuel-mileage tester which should be installed near the driver's seat. The fuel-mileage tester is connected to the engine by means of hoses. A switch should allow the test system to be cut out.



If the test result corresponds to the figures given by the factory, the driving habit or special operating conditions are responsible for a high fuel consumption.

To carry out the test, the following points should be noted:

- 1 - Adjustment of fuel pump, carburetor and ignition must be correct.
- 2 - The engine must have attained operating temperature before conducting the test.
- 3 - The car must be normally laden.
- 4 - Conduct the test on a level road and under average driving conditions. Periods of idling, stop and go operation, short trips resulting in insufficient warm-up, rapid acceleration, and driving at top speed have a definite effect on the fuel consumption.
- 5 - Only trade-mark fuel should be used. The consumption should be determined as follows:

Liter per 100 km (metric)

$$= \frac{\text{Fuel consumed (liter)}}{\text{Length of test course (km)}} \times 100$$

- 6 - The engine and the fuel system should be thoroughly checked, if there is a considerable difference between the result of the fuel-mileage test carried out as outlined above and the nominal fuel consumption figures given by the factory.

**Note.** - A fuel-mileage test by means of a fuel level gauge and the mileage recorder generally gives only an approximate fuel consumption figure and should, therefore, be avoided.



**Fuel Consumption Test on Engine Test Bench**

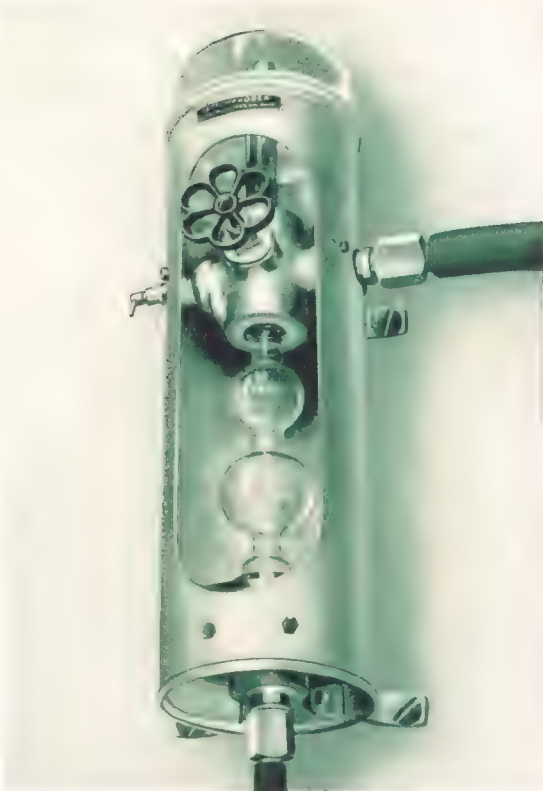
The fuel consumption can also be checked on the engine test bench by means of a gauged test container and a stop-watch. The consumption can be determined by making the engine subject to a given load and speed during a fixed time.

The consumption figures for 100 cu. cm (6 cu. ins.) are given in the chart below.

**Example:**

With a speed of 100 r.p.m. and a brake load of 4.60 kg (10 lbs.), 100 cu. cm (6 cu. ins.) should be used up within 86 and 93 seconds.

The chart only applies to engines which are completely broken in (run in) and equipped with a SOLEX Carburetor 28 PCI.



The chart contains only the speeds equivalent to 50 km p. h. (30 miles), 70 km p. h. (45 miles), 90 km p. h. (55 miles), and full throttle. All further measurements at other speeds are unnecessary, as the characteristic of the consumption is equal throughout the total range of load.

Brake Load (kg)	R.P.M.	Time for consumption of 100 cu. cm (6 cu. ins.) fuel (seconds)
3.2	1500 (50 km p.h./30 m.p.h.)	131 — 145
4.6	2100 (70 km p.h./45 m.p.h.)	86 — 93
6.45	2700 (90 km p.h./55 m.p.h.)	54.5 — 58.0
8.00—8.3	3000 (full throttle)	40 — 43.5

**Note.** - Generally, the brake load is between 8.0 and 8.3 kg at 3000 r.p.m. If a higher brake load is reached, the time for the consumption of 100 cu. cm (6.0 cu. ins.) may go down to 38.5 sec. If the given brake load is not reached, the consumption may require 44.5 sec.



## Carburetor Adjustment

### Specification Data

### Compression Ratio

	6.1	6.6
Venturi . . . . .	21.5 mm dia.	21.5 mm dia.
Main jet . . . . .	122.5	117.5
Air correction jet . . . . .	200	195
Pilot jet . . . . .	50	50
Pilot jet air bleed . . . . .	0.8 mm dia.	0.8 mm dia.
Pump jet . . . . .	50	50
Pump air correction jet . . . . .	2.0	2.0
Emulsion tube . . . . .	29	29
Float needle valve . . . . .	1.5	1.5
Float weight . . . . .	12.5 grams	12.5 grams
Pump feed . . . . .	0.50 ± 0.10 c.c. per stroke	0.50 ± 0.10 c.c. per stroke

## Fuel Consumption Test on Brake

Brake load (kg)	Engine speed (r.p.m.)	Corresponding car speed		Time for consumption of 100 c.c. (6 cu. ins.) fuel in seconds	
		(km)	(miles)	6.1 Ratio	6.6 Ratio
3.15	1500	50	31	128 — 138	138 — 148
4.65	2100	70	43	85 — 92	90 — 97
6.65	2700	90	56	54.5 — 58.5	55.5 — 59.5
7.85	3000	100	62	43 — 46	43 — 47
8.7—9.1	3400	Full throttle		33 — 36	34 — 37

## Carburetor "Icing"

During the cold season, some VW owners complain about poor acceleration and a tendency of the engine to stall when idling, coupled with an excessive fuel consumption. A thorough check usually does not reveal any defect or maladjustment. An "icing" of the carburetor is frequently found to be responsible for the trouble.

This phenomenon is caused by certain weather conditions. It may occur at temperatures between 0° and +10° C (32° and 50° F). Temperatures between +2° and +6° C (35,6° and 42,8° F) have proved to be particularly critical in this connection. The degree of humidity has, apart from the temperature, an important bearing on „icing“. The tendency of the carburetor to freeze up is promoted at a humidity in excess of 70 per cent.

Following are the symptoms of carburetor "icing":

- a - Engine stalls when idling. This may happen even after a longer period of operation (10—15 minutes) in city traffic. The best proof that the stalling is attributable to "icing" is when the engine runs smoothly again after having waited for a few minutes with the engine idling. The reason for the stalling is ice forming on the throttle valve and freezing up the space between throttle valve and carburetor throat. It is also possible that the idle port is blocked by ice.
- b - Poor acceleration under small loads. This is also caused by the conditions detailed under "a-". The ice will melt when the carburetor receives sufficient heat from the engine. That is why any ice will hardly be detected in checking the engine at the workshop.
- c - It is possible that ice will form at the air correction jet and at the mixture outlet holes in the spraying well, which may substantially increase the fuel consumption.

The tendency of the carburetor to freeze varies with the various brands and grades of fuel. It can be diminished by adding anti-freeze agents to the fuel. Some well-known brands of fuel contain such agents, at least during the critical season.

## Preignition

The commercial fuels of some countries vary quite considerably in respect to certain qualities which are not exactly laid down in the usual specifications. This also applies to the self-ignition temperature of the fuel. With a somewhat lower self-ignition temperature preignition can occur in the engine, especially under the following circumstances:

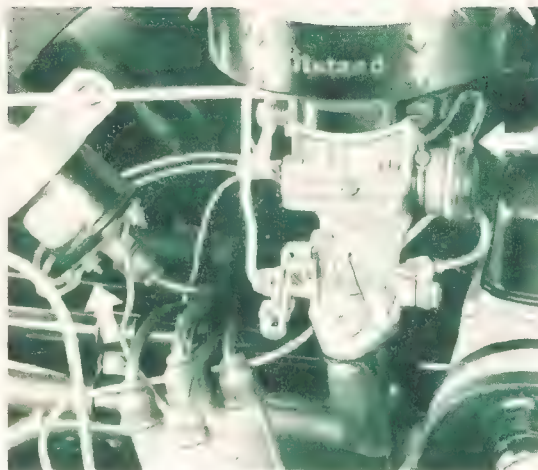
- 1 - Incorrect carburetor idling adjustment (too rich or too fast).
- 2 - Incorrect ignition timing.
- 3 - Incorrect cooling air throttle ring adjustment.
- 4 - Excessive accumulation of combustion residues in combustion chambers in connection with working conditions, way of driving and fuel used.
- 5 - Inadequate cooling of the engine owing to insufficient tension of the fan belt or dirty exterior of the engine.

In exceptional cases where preignition cannot be dealt with satisfactorily in the workshop, a pilot jet with electro-magnetic shut-off valve (Part No. 111 129 413) is available for service installation.



### Installation:

- a - Remove standard pilot jet and install pilot jet with electro-magnetic shut-off valve.
- b - Attach connecting cable to terminal of pilot jet with electro-magnetic shut-off valve and to terminal 15 of the ignition coil (length of the cable about 400 mm/15.74").



### Operation

When the ignition is turned off, the jet needle, operated by an electromagnet, closes the pilot jet so that no more fuel can pass through. This practically eliminates preignition. The jet is opened again by turning the ignition on.

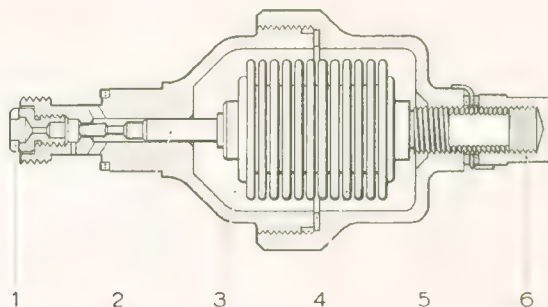
By turning the hand lever the electromagnet is switched off. The pilot jet with electro-magnetic shut-off valve is switched on when the handle of

the lever points towards the fan housing. In the opposite position it works like an ordinary pilot jet.

For cleaning purposes the jet piece can be removed from the housing. Maintenance other than this is not necessary.

## High Altitude Corrector

To ensure satisfactory mixing in the carburetor even at high altitudes, a high altitude corrector (Spare Part No. 111 129 501) can be fitted in 1192 cu. cm engines in place of the main jet carrier.



## Operation of the high altitude corrector

The main jet carrier is replaced by the high altitude corrector which is mounted in the same manner as the main jet carrier.

The main jet (1) through which the fuel, coming through an annular chamber from the float housing, has to pass, is screwed to one end of the high altitude corrector.

The fuel is supplied to the main jet through 4 oblique bores, and through a small bore between the main jet and the 4 oblique bores. The fuel also flows into the thermostat chamber (3).

The governor thermostat (4) is supported axially and fixed in position at the end opposite to the main jet, by means of a pin which is screwed into the housing. Mounted at the other end of the thermostat, the needle (2) slides freely in the passage leading to the main jet.

As the thermostat (4) expands due to the atmospheric pressure at high altitude, the needle throttles progressively the fuel supply for the main jet i.e. the change in atmospheric pressure alters the length of the thermostat and, consequently, the position of the needle, thus governing the fuel supply.

At sea level, the needle will be in a position which does not affect fuel consumption.

### Caution

When the high altitude corrector is mounted, the governor thermostat is properly set by means of the adjusting nut (6) which is secured with a lock washer (5). This adjustment must not be altered by any means.



# Tools and Appliances

# K

## 1 - VW Special Service Tools

VW 126 a	Fuel Pump Wrench
VW 328 a	Fuel Pump Push Rod Gage
VW 328 b	Fuel Pump Diaphragm Gage

## 2 - VW Workshop Equipment for Local Manufacture

(The earlier VW Number is given in brackets)

VW 663	(VW 364) Fuel Pump Tester
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## 3 - Normal Hand Tools

Screwdriver, 6 mm  
Carburetor screwdriver  
Combination pliers  
Pipe wrench  
Mechanic's hammer, 300 grams  
Triangular scraper  
Open-end wrench, 8 mm  
Open-end wrench, 11 mm  
Open-end wrench, 12 mm  
Open-end wrench, 14 mm  
Open-end wrench, 17 mm  
Box wrench, 14 mm  
Box wrench, 17 mm  
C-shaped box wrench (Starterblockschlüssel)  
Wire brush  
Hand vice  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl  
Caliper square, 300 mm in length, measuring 1/50 mm  
Tap M 6  
Die stock, size 1  
Die M 6  
Tap wrench, size 1, adjustable  
Drill, 5.0 mm  
Drill, 7.0 mm  
Inspection lamp with cable and plug  
Electric drill

## 4 - Supplementary Workshop Equipment

Fuel mileage tester  
Engine test stand





## Contents:

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- 3 - Front Axle Disassembly and Assembly
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- 13 - Adjustment of Camber, Caster and Toe-in
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# Description of Front Axle



## General Description

The front axle consists of two rigidly joined tubes secured to the frame head by means of four bolts. The outer ends of the axle tubes carry the four torsion arms, which are free to pivot in two fiber bushes each. The trailing torsion arms are attached to the torsion bars to transmit road shock. The torsion bars are anchored in the center to counteract twisting and lateral movement and to segregate road shock to one side or the other. The torsion arm ends are connected to the torsion arm links by adjustable pins, which are free to pivot. The stub axle (steering knuckle) swivels on a king pin, which passes through bushes in the torsion arm link. A steering damper is fitted between the upper end of the stub axle and the torsion arm link. Front axle tubes, torsion arms and torsion arm link nearly form a parallelogram. Hydraulic, double-acting telescopic shock absorbers dampen road shocks and take up the return swing. Stops with rubber buffers prevent excessively violent springing action.

## Lubrication

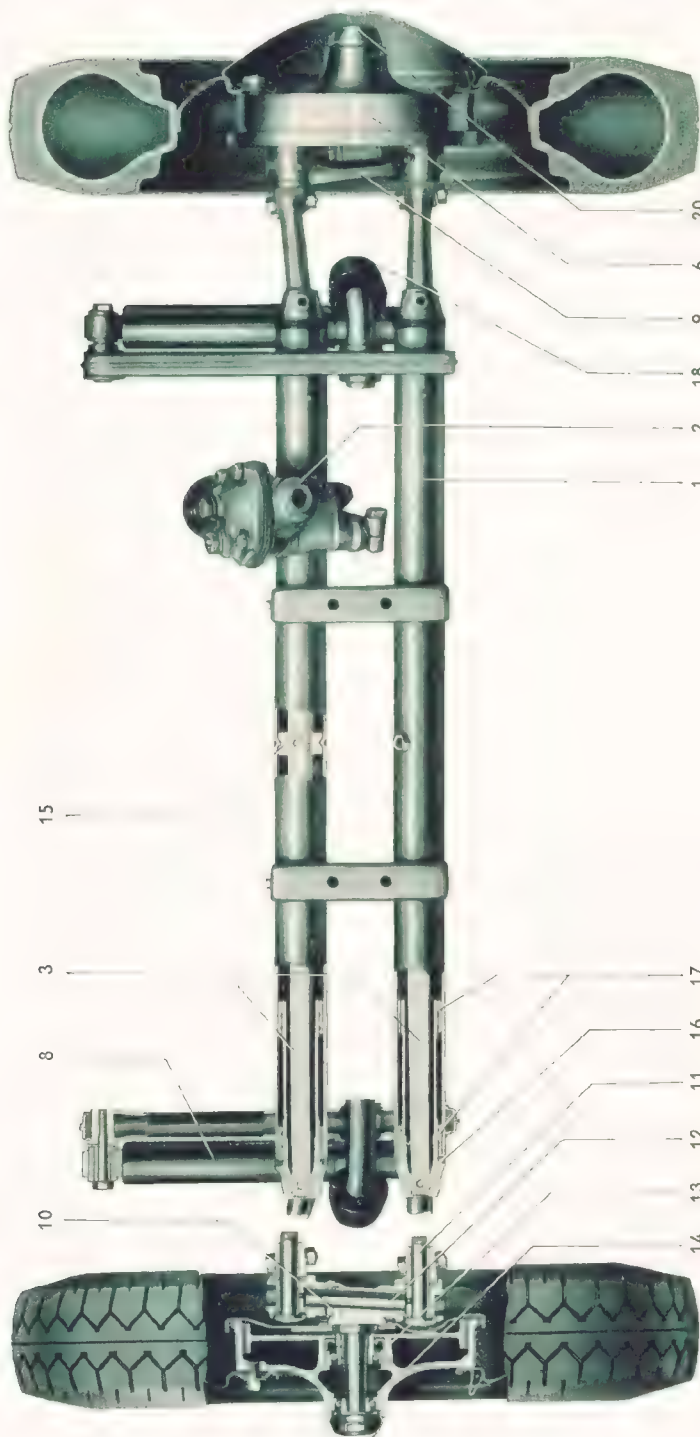
Under normal driving conditions, the front axle should be lubricated at regular intervals as prescribed in the Lubrication Chart. If, however, the car is mainly used on rough roads or if it is driven not more than 12—15 000 km (7500—9500 miles) in a year, that is a monthly average of below 1000 km (600 miles), it is recommended to apply an additional lubrication to the one suggested in the chart, say every 1250 km (800 miles), particularly at the lubricating points of the torsion arm links and the outer tie (track) rod joints. The front wheel bearings should be thoroughly cleaned and repacked with grease once a year.

**Important.** — A perfect lubrication of the front axle bearing points is only insured with the front axle raised off its wheels (unloaded condition). Grease should be injected into the nipples until the excess grease begins to emerge at the edges of the lubrication points. The service life of the front axle depends on skilled lubrication with trade-mark lubricants which correspond with the specifications given by the Volkswagenwerk. When lubricating, the grease nipples and grease guns should be perfectly clean.

## Maintenance

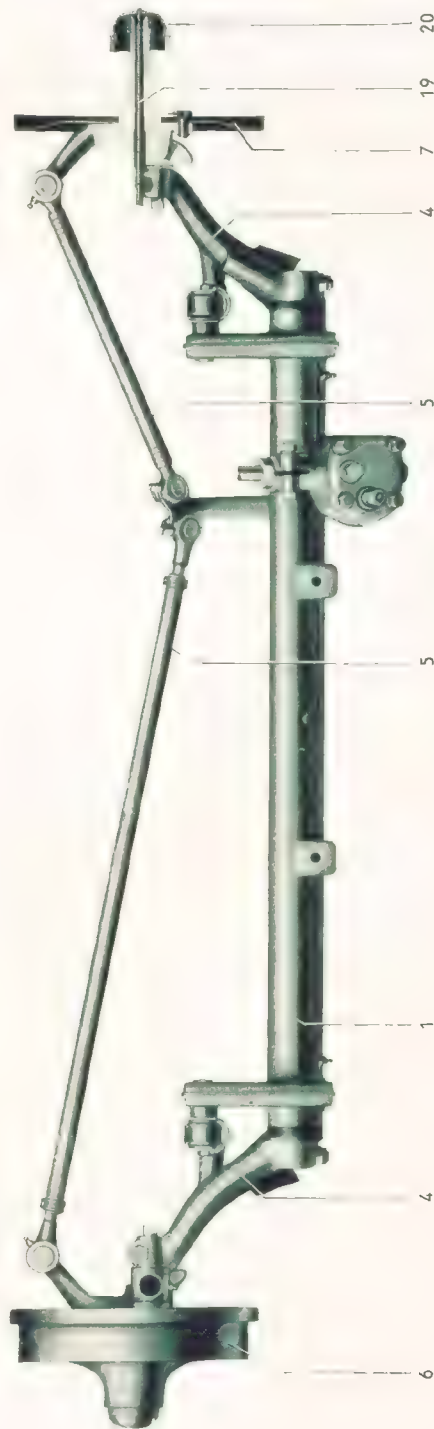
To maintain the riding qualities and the standard of safety of the car, regular inspections and maintenance operations of the front axle and steering are absolutely necessary. The individual operations are:

- 1 - Inspection and adjustment of front wheel bearings.
- 2 - Inspection and adjustment of torsion arm link pins.
- 3 - Inspection and adjustment of toe-in at front wheels.
- 4 - Inspection of shock absorbers for proper function and security.
- 5 - Inspection of wheel bolts for tightness.
- 6 - Inspection and recification of tire pressure.



**Volkswagen Front Axle**  
(Sectional View)

- 1 - Front Axle Tube
- 2 - Steering Gear
- 3 - Torsion Bar
- 4 - Torsion Arm
- 5 - Tie (Track) Rod
- 6 - Brake Drum
- 7 - Brake Back Plate
- 8 - Shock Absorber
- 9 - Torsion Arm Link
- 10 - Stub Axle (Steering Knuckle)
- 11 - Torsion Arm Link Pin
- 12 - King Pin
- 13 - Front Wheel Bearing, inner
- 14 - Front Wheel Bearing, outer
- 15 - Center Anchor
- 16 - Seal
- 17 - Torsion Arm Bush
- 18 - Rubber Buffer
- 19 - Speedometer Cable
- 20 - Grease Cap





## Removal

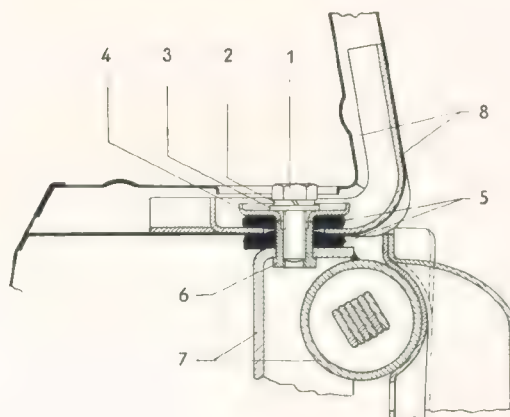
- 1 - Lift the car and support it on trestles.
- 2 - Remove front wheels.
- 3 - Hydraulic brake: Disconnect brake hoses at brake back plates and plug them up, using wooden plugs.

Mechanical brake: Remove frame head cover, disconnect cable from stop light switch, remove stop light switch, and unhook brake cables from brake push bar.

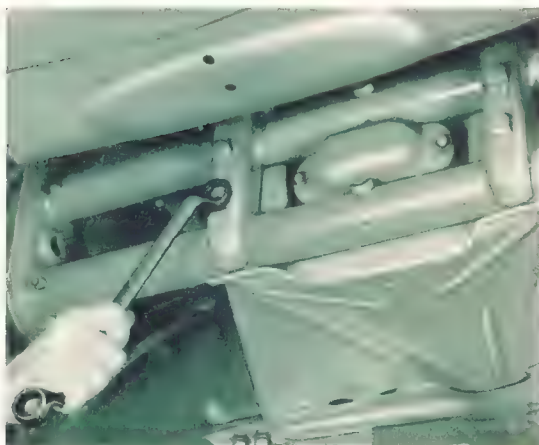
**Important.** — When replacing the front axle, the brake cables must remain on the axle.

- 4 - Remove speedometer cable at left stub axle (steering knuckle).
- 5 - Loosen steering column clamp and withdraw steering column with steering wheel, after having pulled out brush holder and brush from steering column tube.
- 6 - Remove outer tie (track) rod joint of right tie rod, using Special Tool VW 266 a.
- 7 - Remove the two body mounting bolts M 10.
- 8 - Remove the four front axle mounting bolts, after the lock plates have been prised off, and take off the front axle.

- 2 - Before installing the front axle, fit a rubber packing to the threaded bushes on the front axle mounting brackets.



- 1 - Body mounting bolt
- 2 - Lockwasher
- 3 - Washer
- 4 - Spacer
- 5 - Rubber packings
- 6 - Threaded bush
- 7 - Front axle
- 8 - Body



## Installation

This is accomplished by reversing the above procedure:

- 1 - Use new lock plates.

- 3 - Make sure that there is a good ground connection at the steering column coupling.

- 4 - When pushing the steering column on the coupling flange pin, make sure that the steering wheel is properly positioned. Secure steering column clamp screw with a new lock plate.

- 5 - Hydraulic brake:

Take care that the brake hoses are not twisted. Bleed and adjust braking system.

Mechanical brakes:

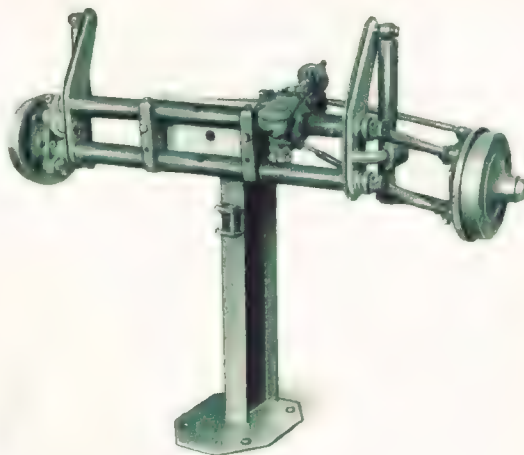
Adjust brakes.

- 6 - Check toe-in, camber and caster.

## General

All operations to be carried out on the removed front axle can best be accomplished with the axle mounted on the Holding Fixture VW 308 in conjunction with the plate VW 309.

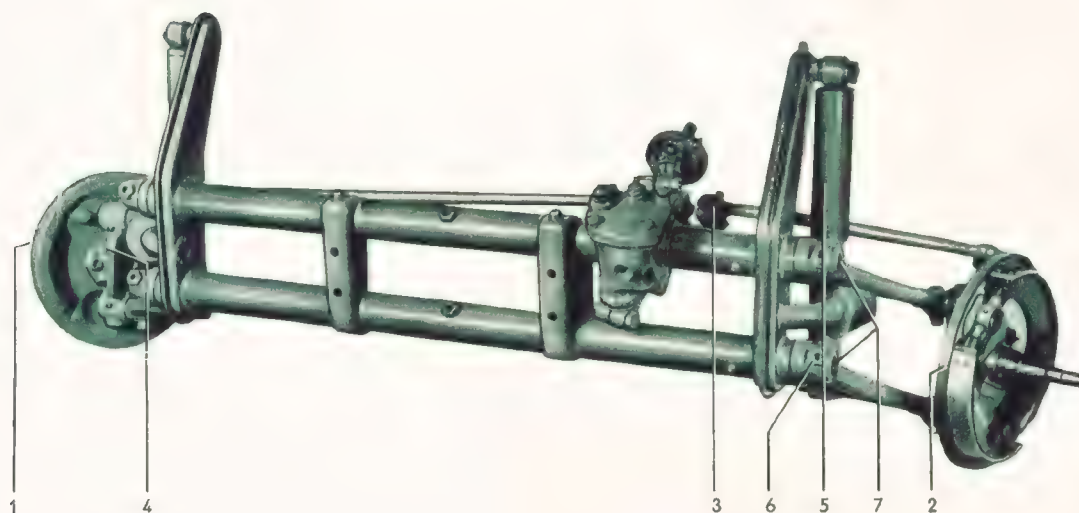
As the front axle can also be partly disassembled while in position in the vehicle, repairs can generally be effected without having to remove the axle.



To facilitate disassembly and assembly, the following sequence of operations should be followed:

## Disassembly

- 1 - Remove brake drums.
- 2 - Remove brake back plates.
- 3 - Remove tie (track) rods.
- 4 - Remove torsion arm links and stub axles (steering knuckles).
- 5 - Remove shock absorbers.
- 6 - Remove torsion arms and seals.
- 7 - Remove torsion bars.



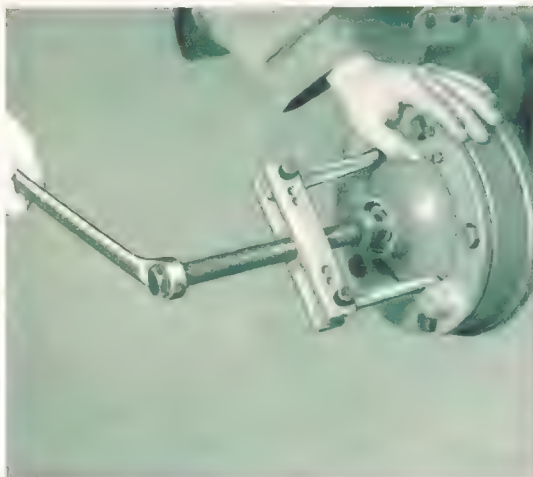
## Assembly

Assembly is accomplished by reversing the above procedure. Reference should be made, however, to the following pages containing detailed information and special hints as to the correct removal and installation of the individual parts.

## Removing and Installing Brake Drum

### Removal

- 1 - Lift car and support it on trestles.
- 2 - Take off hub cap and remove the wheel.
- 3 - Remove grease cap. At left wheel hub: first remove cotter pin securing speedometer cable.
- 4 - Turn up lock plate and remove nuts and thrust washer (at left stub axle: left-hand thread!).
- 5 - Pull off brake drum, using Special Tool VW 202 in conjunction with VW 202 c, d, and i. The nose of the thrust pad must engage with the slot cut into the wheel spindle.



### Installation

This is a reversal of the above operations, but the following points should be noted:

- 1 - Check tapped holes of brake drum for damage and make sure that the braking surface is smooth.

- 2 - Clean brake drum hub and front wheel bearing. Lubricate front wheel bearing with special grease VW - A 051.

- 3 - Adjust front wheel bearing as prescribed.

## Reconditioning Brake Drum

### Re-Tapping Brake Drum Holes

Brake drums with damaged threads for the wheel mounting bolts can be repaired by cutting a thread M 14×1.5 in the five tapped holes M 12×1.5 of the drum. Oversize wheel bolts M 14×1.5 are available to suit the enlarged holes.

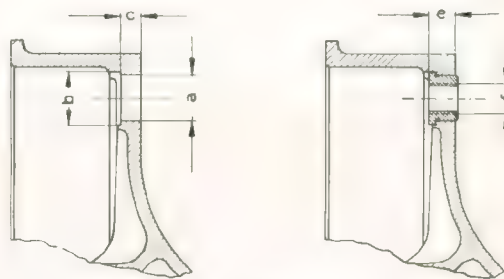
- 1 - Bore up the brake drum holes with a drill 12.0—12.1 mm diam.
- 2 - Cut thread M 14×1.5.

### Tapped Inserts for Brake Drum Holes

Another method of reconditioning brake drums having damaged threads is to press tapped inserts M 12×1.5 into the brake drum holes.

- 1 - Bore up the five brake drum holes with drill 17.8 mm diam.
- 2 - Ream the holes with reamer 18 H 8 = 18.000 — 18.027 mm (a).
- 3 - Counterbore the holes with a drill 20.0—21.5 mm diam. (b) as far as there will remain 8.0—8.3 mm of their length (c).

- 4 - Press the tapped inserts into the brake drum holes. The dimension 9.8—10.3 mm (e) must be strictly adhered to. The chamfered portion 0.5×45° of the insert may project from the brake drum surface, but never the knurled portion.



$$a = 18 \text{ } \phi \text{ H } 8 = \begin{matrix} 18.027 \\ 18.000 \end{matrix} \text{ mm } \phi$$

$$b = \frac{20.0}{21.5} \text{ mm } \phi$$

$$c = \frac{8.3}{8.0} \text{ mm}$$

$$e = \frac{10.3}{9.8} \text{ mm}$$

$$f = \text{M } 12 \times 1.5$$



### Refacing Brake Drum

If the braking surface of the drum is scored, out-of-round or bell-mouthed, it may be refaced on a lathe.

- 1 - Turn the drum to an inside diameter of 231.5 mm (9.11"). The thickness of a refaced drum must never be below 4 mm (.16").

The braking surface must not be tapered more than 0.1 mm (.004").

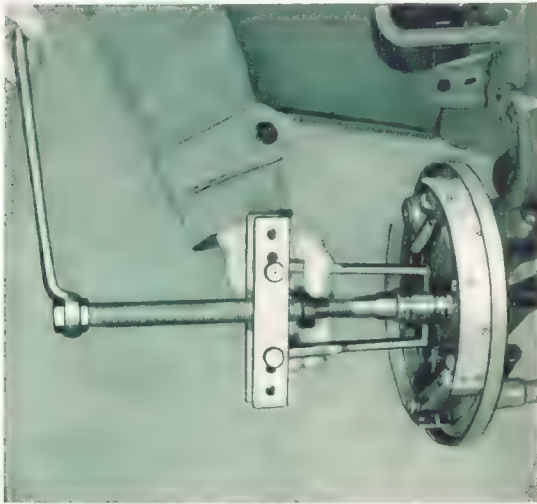
The permissible lateral and radial run-out of the drum is 0.25 mm (.010").

- 2 - The brake shoes of refaced drums must be fitted with oversize brake linings to correspond with the radius of the braking surface.

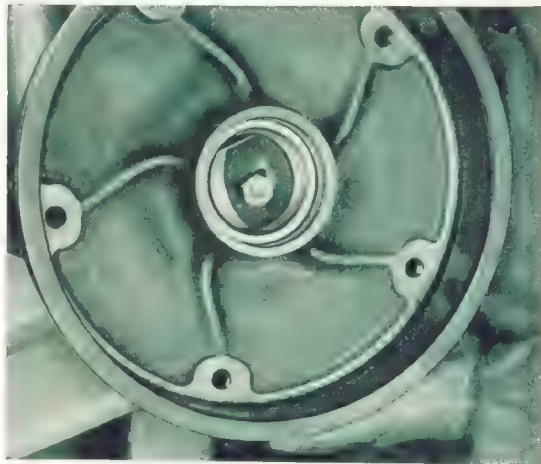
## Removing and Installing Front Wheel Bearings

### Removal

- 1 - Remove brake drum.
- 2 - Pull off the spacer and the inner race of the inner bearing by means of the puller VW 202 in conjunction with VW 202a-T and VW 202i.



- 3 - Remove oil seal from drum hub and take out ball cage.
- 4 - Remove outer race of the inner bearing (62 mm diam.) on VW Repair Press with thrust plate VW 447 in conjunction with VW 412 and VW 446.
- 5 - Remove outer race of the outer bearing (52 mm diam.) on VW Repair Press with punch VW 407 in conjunction with VW 401.



### Installation

This is accomplished by reversing the above procedure, but the following points should be observed:

- 1 - Thoroughly clean brake drum prior to its installation. Remove all traces of old grease from chamber between the bearing seats. If there is no press fit of the outer ball races, renew brake drum.
- 2 - Clean ball bearings in a volatile cleaning fluid and see to it that they are in a proper condition. Replace them if necessary.

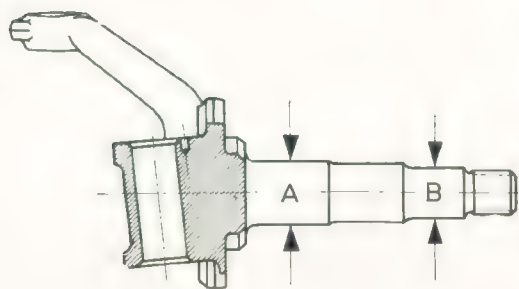
**Important.** — Ball races or balls must never be replaced separately.



3 - Inspect spacer of inner bearing for cracks and wear, replace if necessary, using the sleeve VW 244 to drive it into position. A correct sealing of the brake drum oil seal is only insured, if the surface of the spacer is absolutely clean and smooth.



4 - Install inner ball race of inner bearing with sleeve VW 244. If the seating surfaces for the inner ball races have become worn by a repeated removal of the races, they may be chrome-plated and re-ground to insure a good wringing to sliding fit of the races.



Seating A for inner bearing  $\begin{matrix} = 25.000 \text{ mm diam.} \\ 25_{h6} & = 24.987 \text{ mm diam.} \\ & 0.9842 \text{ ins. diam.} \\ & 0.9837 \text{ ins. diam.} \end{matrix}$

Ball bearing inner dia.  $\begin{matrix} = 25.00 \text{ mm} \\ = 25.01 \text{ mm} \end{matrix}$

Seating B for outer bearing  $\begin{matrix} = 19.993 \text{ mm diam.} \\ 20_{g5} & = 19.984 \text{ mm diam.} \\ & 0.7871 \text{ ins. diam.} \\ & 0.7868 \text{ ins. diam.} \end{matrix}$

Ball bearing inner dia.  $\begin{matrix} = 20.00 \text{ mm} \\ = 20.01 \text{ mm} \end{matrix}$

5 - Install outer race of outer bearing on VW Repair Press with thrust mandrel VW 432 in conjunction with VW 411.

6 - Install outer race of inner bearing on VW Repair Press with thrust block VW 433 in conjunction with VW 401, VW 412, and VW 420.

7 - From April 1957 the space between the inner ring and the bearing cage is filled with special grease. The hollow space in the brake drum between the two bearings is no longer filled. The grease caps have not been filled with grease since August 1953.

Cars in use should be lubricated with special grease (VW — A 051) every 25.000 km (15.000 miles).

8 - Make sure that the oil seals are in good condition and correctly seated.



9 - Install brake drum and drive the inner race of the outer bearing into position, using sleeve VW 244.

10 - Make sure the thrust washer is correctly positioned. A tilted washer causes maladjustments.

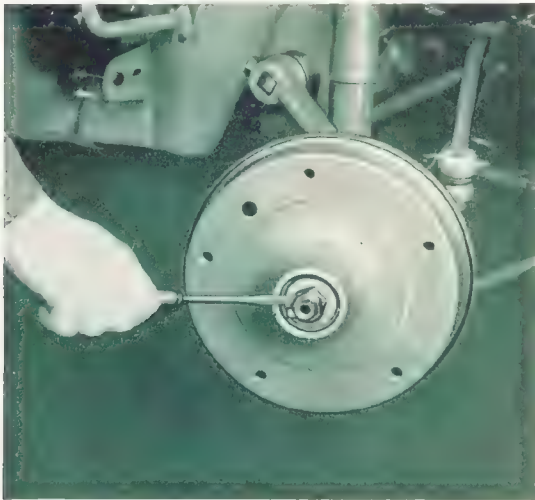
11 - Use new lock plate.

## Adjusting Front Wheel Bearings

When adjusting front wheel bearings, the following points should be observed to avoid premature wear and damage to the bearings.

### Inspection

- 1 - Take off grease cap and remove all surplus grease.
- 2 - Adjustment is correct if the thrust washer at the outer bearing just allows to be moved laterally by a screwdriver and if no bearing play can be felt when rocking the brake drum.



- 3 - If necessary, fill grease cap with Universal Grease VW - A 052.

### Adjustment

- 1 - Pry off noses of lock plate at stub axle (steering knuckle) nuts.

- 2 - Loosen nuts by means of the two open end wrenches 27 mm, VW 113.

- 3 - If necessary, use a new lock plate.

- 4 - Tighten inner nut until the thrust washer at the outer bearing just allows to be moved laterally by a screwdriver and no bearing play can be felt when rocking the brake drum. But this check should only be carried out with the outer nut already tightened, as the thread clearance may permit the outer nut to disturb the required clearance of the thrust washer due to the force imposed on the inner nut.



- 5 - Secure nut by alternately bending down nose of lock plate.



## Adjusting Torsion Arm Link Pins

### General Description

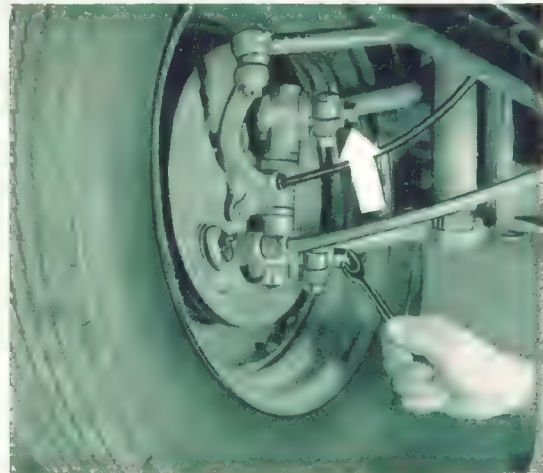
The torsion arm link pins should be checked at regular intervals as called for in the Maintenance Chart.

### Inspection

- 1 - Raise the car.
- 2 - Rock the wheel by hand to check the end play between torsion arm link and torsion arms. If excessive play is present, adjust torsion arm link pins.

### Adjusting Torsion Arm Link Pins

- 1 - Raise the car.
- 2 - Back off pinch bolts at torsion arm eyes.
- 3 - First grease torsion arm link pins thoroughly, at the same time turning the pins in both directions to remove old grease and dirt.
- 4 - Tighten the torsion arm link pins to a degree which will still allow a free movement between torsion arms and torsion arm link without perceptible play. To effect this adjustment, first fully tighten torsion arm link pins and then back them off approx.,  $\frac{1}{8}$  turn. Finally retighten the pins carefully until the first resistance is felt.



If no correct adjustment can be effected, the shims are worn and should be replaced by new ones.

- 5 - Tighten pinch bolts.

### Important!

After the torsion arm link pins have been adjusted, it is absolutely necessary to check the toe-in.

## Removing and Installing Torsion Arm Link with Stub Axle (Steering Knuckle)

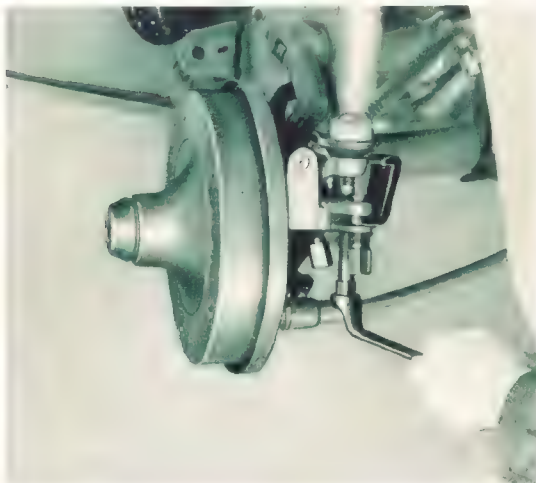
(Front axle in position)

### Removal

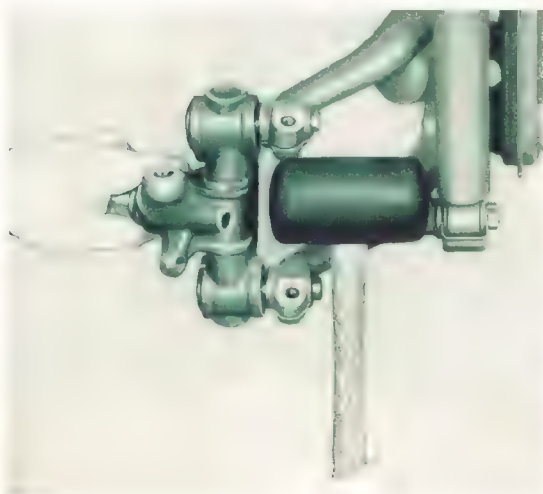
- 1 - Raise front end of car and support it behind the frame head.
- 2 - Remove front wheel.
- 3 - Left front wheel: detach speedometer cable.
- 4 - Remove brake drum and brake back plate. It is not necessary to detach brake line or brake cable.

- 5 - Remove outer tie rod joint with tool VW 226a.

- 6 - Remove pinch bolts at torsion arm eyes.

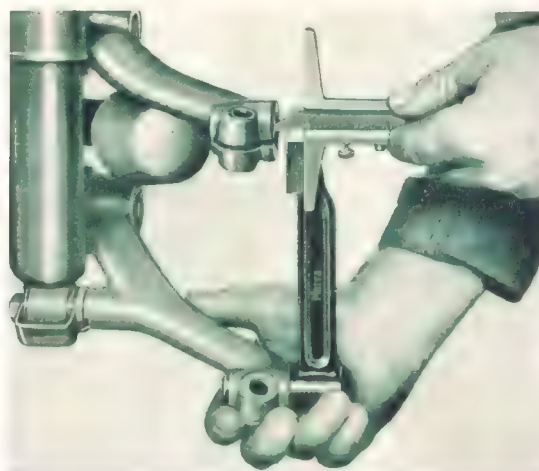


7 - Remove torsion arm link and stub axle by equally driving out both torsion arm link pins as shown below.



2 - Examine faces of torsion arm eyes for wear and roughness. If necessary, reface them with cutter VW 217.

3 - Using gauge VW 270a, measure displacement of eye faces, which should be 7 mm (0.28"). Departures from that dimension must not be more than  $\pm 2$  mm (0.08"). Correct the displacement with shims of 0.5 mm (0.02") thickness.

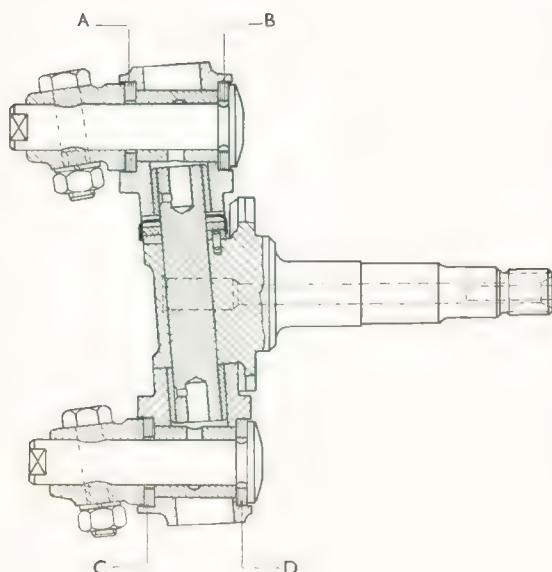


#### Installation

This is a reversal of the above procedure, but the following points should be noted:

1 - Check for wear and replace as necessary: torsion arm link pins, torsion arm link pin bushes, and shims.

Arrangement of Shims on Torsion Arm Link Pins				
Displacement in mm	Number of Shims for			
	Upper Torsion Arm		Lower Torsion Arm	
	Inner Shims (A)	Outer Shims (B)	Inner Shims (C)	Outer Shims (D)
5	3	7	7	3
5,5	4	6	7	3
6	4	6	6	4
6,5	5	5	6	4
7	5	5	5	5
7,5	6	4	5	5
8	6	4	4	6
8,5	7	3	4	6
9	7	3	3	7



**Note:**

- a) There must always be 10 shims fitted to one torsion arm link pin.
- b) If the displacement is 7 mm, there are 5 shims on each side.
- c) If the displacement is in excess of 7 mm, shims from B should be added to A and shims from C should be added to D.
- d) If the displacement is below 7 mm, shims from A should be added to B and shims from D should be added to C.

**Example:**

- a) The value measured is to be raised or lowered to the nearest value indicated in the above table. If the displacement is found to be 8.3 mm, the value should be raised to 8.5 mm.

b) The difference to the nominal dimension (7 mm) is  $8.5 - 7 = 1.5$  mm. This value corresponds to the thickness of 3 shims of 0.5 mm each.

c) The shims must be arranged as follows:

Upper Torsion Arm		Lower Torsion Arm	
Inner Shims (A)	Outer Shims (B)	Inner Shims (C)	Outer Shims (D)
7	3	4	6

If deviation exceeds the limits of  $\pm 2$  mm, it is not permissible to add further shims. Misalignments can be determined by removing the torsion arms and checking them on the test plate VW 282b. The front axle tubes should be checked for alignment by means of the test appliance VW 256a. Twisted torsion arms must in all cases be renewed. No attempt should be made to straighten them.

4 - Grease torsion arm link and shims with Universal Grease VW - A 052. If the displacement has been corrected as outlined above, the torsion arm link pins can easily be pushed into the torsion arm eyes and the faces of the upper and lower torsion arms simultaneously make perfect contact with the shims.

5 - Adjust torsion arm link pins.

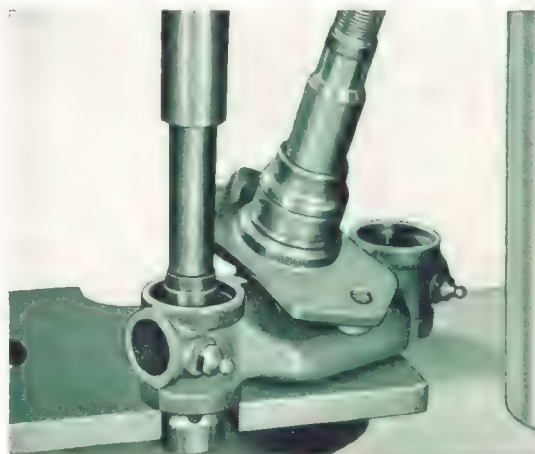
6 - After installation of brake back plate, secure mounting bolts with a piece of wire.

7 - Check camber and toe-in of front wheels.

## Removing and Installing Bushes for Torsion Arm Link Pins

**Removal**

- 1 - Remove torsion arm link and stub axle (steering knuckle).
- 2 - Remove torsion arm link pin bushes (with pilot drift 133 or on VW Repair Press with thrust mandrel VW 434 in conjunction with VW 408 and VW 401).

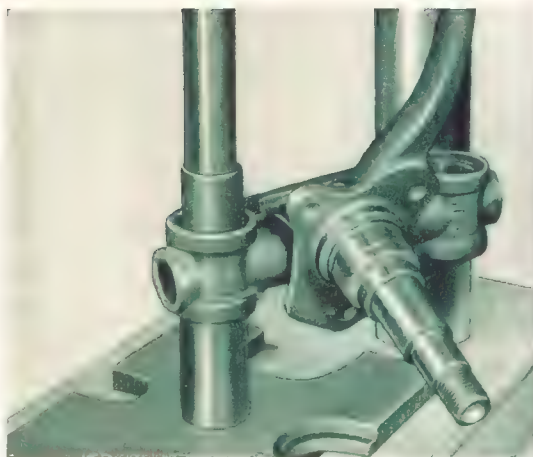




## Installation

When installing torsion arm link pin bushes, the following points should be heeded:

- 1 - Check torsion arm link for correct offset by means of gauge VW 259.
- 2 - Check depth of bores for torsion arm link pin bushes using gauge VW 259.
- 3 - Check clearance of king pin in the bushes. Replace pin and bushes if necessary.
- 4 - The bushes for the torsion arm link pins must be placed in an oil bath of 80° C (175° F) for 24 hours before they are installed.
- 5 - Install bushes for torsion arm link pin on VW Repair Press with punch VW 408 in conjunction with VW 401 and VW 418. The bushes must be a force fit in the torsion arm link.



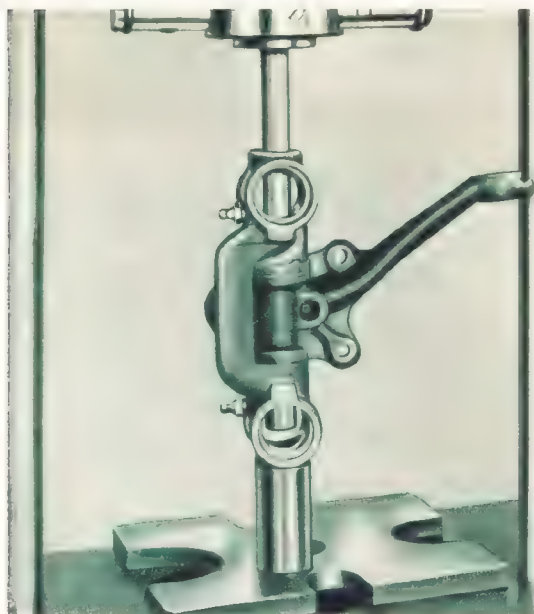
### Note:

When replacing bushes for torsion arm link pins and king pins note correct position of grease passages. On Volkswagens manufactured from October 1952, the following type torsion arm link is used: Two grease nipples, bushes for torsion arm link pins having lubrication groove inside, lubrication passages in king pin drilled in both ends at level of bushes. No dust covers fitted.

## Removing and Installing Stub Axle (Steering Knuckle)

### Removal

- 1 - Remove torsion arm link pin bushes.
- 2 - Drive out king pin on VW Repair Press with punch VW 411 in conjunction with VW 401 and VW 418. To avoid damage, the stub axle should be heated in an oil bath of 80—90° C (175—195° F).



- 3 - Remove stub axle, thrust washer and cover from torsion arm link.

### Checking Stub Axle

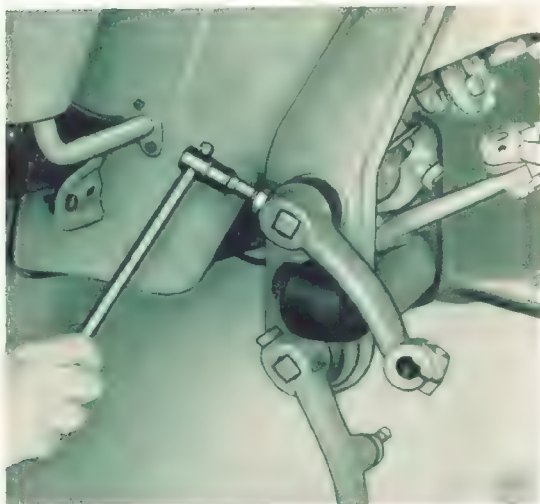
- 1 - Remove front wheel bearing spacer. Check the stub axle for bends and twisting, using gauge VW 258a. Place stub axle in gauge and check position of seating surface on the eye for the tie rod ball stud. The hole in the steering arm should align with the hole in the gauge.



## Removing and Installing Torsion Arms

### Removal

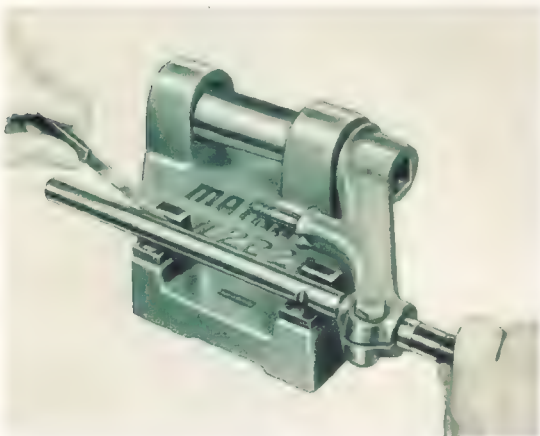
- 1 - Remove torsion arm link and stub axle (steering knuckle).
- 2 - Remove shock absorber.
- 3 - Remove lock nuts and set screws at torsion arms, using angular handle VW 150 in conjunction with the key VW 156.



- 4 - Take off torsion arms and dust seals.
- 5 - Pull off torsion arm rubber stop.

### Checking Torsion Arms

- 1 - Check torsion arms for parallelism and twist by means of gauge VW 282 b.



Insert the torsion arm in the bores of the gauge together with the bushes provided. Insert test mandrel in torsion arm eye and tighten it by the clamping screw. The clearance between the mandrel and the test faces can be checked with a feeler gauge. The permissible departure from the parallelism is 0.2 mm (0.008").

No attempt should be made to straighten bent torsion arms: they must in all cases be exchanged.

- 2 - Check contact faces of torsion arm eyes for wear. If worn, reface them by means of cutter VW 217.



- 3 - Inspect bearing points for wear. If only slightly worn, the torsion arms of both sides are allowed to be interchanged. Signs of seizure or increased wear necessitate a removal of the torsion arms.

#### Note:

Upper and lower torsion arms are not interchangeable (shock absorber mounting!).

### Installation

This is a reversal of the removal procedure, but the following points should be observed:

- 1 - Check torsion arm bushes in front axle tubes for wear, renew them if necessary.
- 2 - The dust seals should be renewed, if damaged or worn.

- 3 - Grease torsion arm with Universal Grease VW — A 052 and insert it in the front axle tube until the tapped hole is in line with the recess in the torsion bar. Tighten set screw and secure it by means of the nut.

- 4 - Lift up upper torsion arm and push rubber stop in position.

- 5 - Re-install shock absorber, using new lock plates, and securely tighten it.

## Removing Shock Absorber Mounting Stud from Torsion Arm

### General Note

When renewing a shock absorber mounting stud at the lower torsion arm, a 0.5 mm (0.02") oversize stud must be used. The hole in the torsion arm has become larger by the pressing in of the original stud so that another stud of the same size would have a loose fit. It is, therefore, necessary to use the oversize stud 12.489—12.500 mm (0.4917"—0.4921") instead of the standard stud 11.989—12.000 mm (0.4720"—0.4724").

### Removal

- 1 - Remove torsion arms.
- 2 - Drive out retaining pin.
- 3 - Remove stud. In the case of the stud being broken off, mark the piece in the torsion arm by means of a center punch and drill a center hole, using a 3 mm (0.12") drill. Bore out the remaining piece with a 10.75 mm (0.423")

drill. The thin shell remaining around the drill will come out during the final drilling revolutions.

### Installation

- 1 - Bore the hole with a 12.3 mm. (0.48") drill and ream it with a reamer 12.5 mm (0.49") P 8 = 12.455—12.482 mm (0.4903"—0.4914"). If a reamer of the size 12.5 mm P 8 should not be available, make the stud to fit the hole by grinding it to the required diameter. The stud must in all cases be a wringing fit in the torsion arm.
- 2 - Press oversize stud in place, taking care that the projecting end has a length of 45.0—45.5 mm (1.77"—1.79").
- 3 - Drill hole 4.00—4.08 mm diam. (0.157"—0.160") for retaining pin in the stud.
- 4 - Drive in retaining pin.

## Torsion Bars

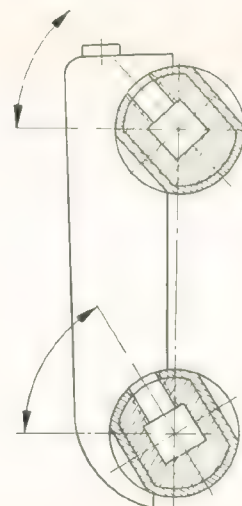
### General Description

The torsion bars of the front axle consist of two groups of 6 steel bands each. The bands are welded at their ends. The torsion bars are anchored in the center of the tubes and secured in position by means of a setscrew and a locking nut each. The mounting angles are:

Upper torsion bar  $45^{\circ} \pm 30'$   
Lower torsion bar  $49^{\circ} \pm 30'$

### Note:

As the mounting angle for the torsion bars in the center anchors corresponds to the number of bands, the torsion bars must only be replaced by those having the same number of bands. The driving characteristics and springing action may otherwise be affected.

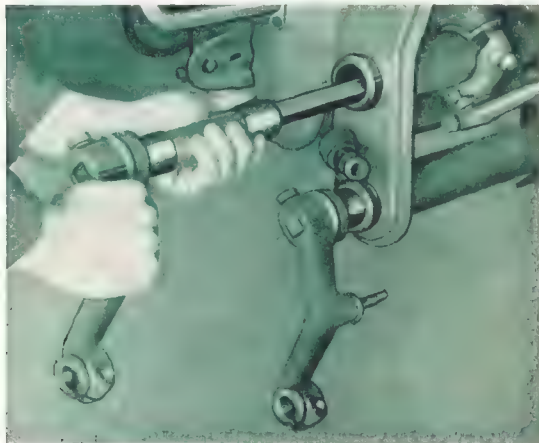




## Removing and Installing Torsion Bars

### Removal

- 1 - Remove torsion arms of one side; if necessary, remove shock absorber.
- 2 - Release lock nut and setscrew at center anchor.
- 3 - Pull out torsion arm of the opposite side together with the torsion bar.



### Note:

It is not necessary to mark the direction of torsion imposed on the bars as this has no bearing on the service life of the bars.

### Checking

- 1 - Clean torsion bars and check them for cracks. Replace if necessary.
- 2 - Loose steel band ends must be arc-welded.

### Installation

This is accomplished by reversing the removal procedure, but the following points should be noted:

- 1 - Inspect torsion arms and torsion arm bushes, renew as necessary.

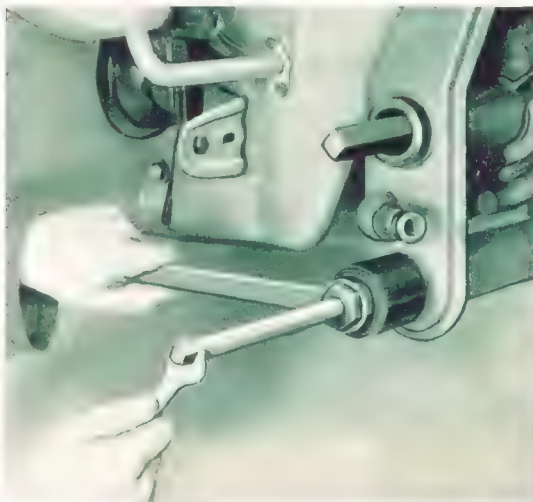


- 2 - When installing torsion bars, note the number of steel bands.
- 3 - Coat torsion bar with Universal Grease VW — A 052 prior to its installation.
- 4 - Bring the recess in the center of the bar in line with the hole for the setscrew; tighten center setscrew and secure with lock nut.

## Removing and Installing Torsion Arm Bushes

### Removal

- 1 - Remove torsion bars.
- 2 - Remove grease nipples in front axle tube.
- 3 - Insert the extractor VW 272 in the front axle tube until it grips behind the outer bush which is then to be extracted first.
- 4 - Extract inner bush.

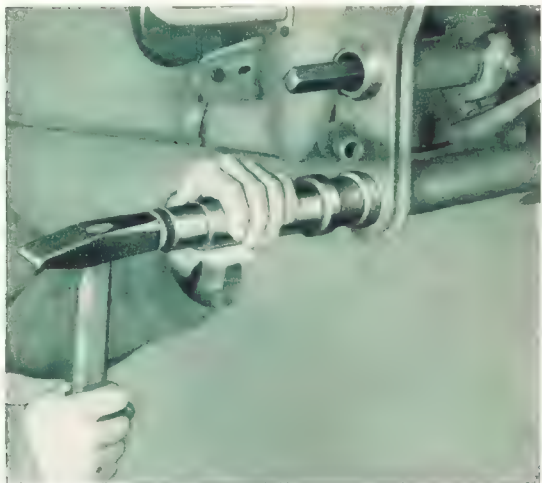


## Installation

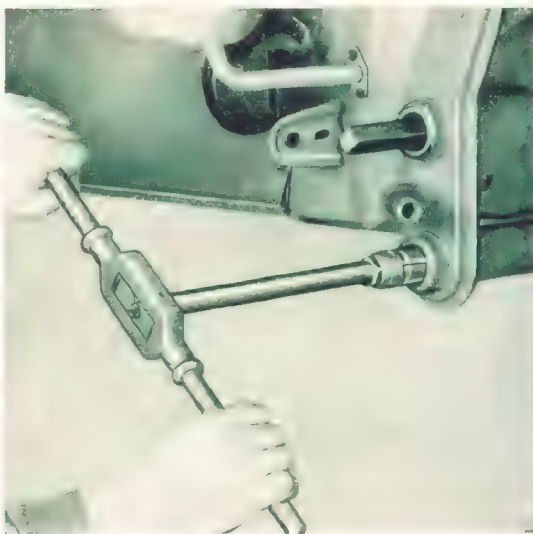
- 1 - Clean inside of front axle tubes, especially the seating surfaces of the bushes, before the bushes are installed.
- 2 - Place inner bush on the longer guide portion of the drift VW 273 a so that the open side of the lubrication groove faces the grease nipple. Drive in the bush until the collar of the drift comes to rest against the tube.



- 3 - Place outer bush on the shorter guide portion of the drift and drive it in position, taking care that the open side of the lubrication groove faces the grease nipple.



- 4 - Ream up outer bush with reamer VW 274 a. The reamer is centered by the guide rod which enters the anchor in the center of the tube.



The bushes are to be reamed up to the following dimensions:

Torsion Arms	Ream Bushes to
36.93—36.95 mm (1.4539"—1.4547")	37.10—37.15 mm (1.4606"—1.4626")

Fitting clearance Torsion Arm-Bush:  
0.15—0.22 mm. (0.006"—0.009").

- 5 - Ream up inner bush. The tapered bush on the guide rod is inserted in the outer bush to center the reamer.
- 6 - Clean front axle tubes by the use of a compressed air line.
- 7 - Refit grease nipples. Renew damaged grease nipples.

## Checking Front Axle Tubes

### General

Front axle tubes which are suspected to be out of alignment after an accident should be checked with the gauge VW 256 a.

### Inspection

- 1 - Check torsion arm bushes for wear. If necessary, install new bushes and ream them up. Badly worn bushes do not permit a correct measuring of the tube alignment.
- 2 - Insert the two mandrels of the gauge VW 256a in the front axle tubes as far as they will go.
- 3 - Contact test plate with the four cylindrical test surfaces of the mandrels and check for twist by means of a feeler gauge.



Permissible deviation from the parallels:  
0.2 mm (0.008").

## Shock Absorbers

The front axle of the Volkswagen is equipped with double-acting, hydraulic shock absorbers of the telescope type which absorb road shock and dampen out spring movements (rebound) after the inequality in the road has been passed. The resistance of the shock absorber is progressive, that is, the damping effect increases when large or sudden movements of the wheel take place.

As both the compression and rebound actions of the shock absorbers correspond to the springing characteristics of the car, no attempt should be made to disturb the adjustment or to fit shock absorbers of other characteristics. The riding qualities would otherwise be seriously affected.

### Inspection and Maintenance

Shock absorber action may be roughly checked by bouncing each corner of the car in turn or by riding the car over a strongly uneven road. A more accurate check can be made by means of

testing appliances which are generally not available at the shop.

A simple check of the removed shock absorber can be carried out by holding it vertically and compressing it by hand. But this method will only give an indication whether or not there is a resistance; the degree of efficiency of the compression and rebound strokes cannot be determined.

If the shock absorber action is found to be insufficient, the shock absorber should be exchanged for a fresh one of the same type. Shock absorbers which indicate a considerable lack of fluid should also be exchanged. If only a slight loss of fluid has taken place and the function of the shock absorber is still satisfactory, there is no need for an exchange, as an adequate fluid reservoir compensates smaller losses. An adding of shock absorber fluid is not possible. In this respect the shock absorber requires no maintenance attention. Service is therefore confined to a check for normal function and a periodical examination of the anchorage to the front axle and the torsion arm.



## Marking and Exchange of Shock Absorber

When exchanging shock absorbers it is permissible to use shock absorbers from different manufacturers on one front axle.

Shock absorbers for the front axle are painted black, for the rear axle red-brown and for the front axle of the VW Transporter gray.

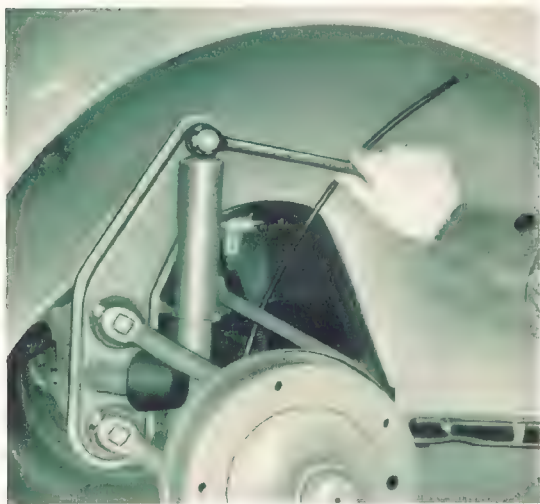
**Attention.** — The telescopic shock absorbers for the VW Rear Axle or the TRANSPORTER Front Axle should, on account of their different operating characteristics, never be fitted to the VW Front Axle.



## Removing and Installing Shock Absorber

### Removal

- 1 - Raise car and remove front wheel.
- 2 - Turn up noses of lock plates at torsion arm stud nut and fixing bolt at front axle beam, and remove nut and bolt.



- 3 - Remove shock absorber.

### Installation

This is accomplished by reversing the removal procedure, but the following points should be observed:

- 1 - Check shock absorber; if necessary exchange shock absorber for a new one of the same type.
- 2 - Examine shock absorber rubber bearings for wear. Renew worn bearings.
- 3 - Inspect fixing stub and bolt for wear and replace them if necessary.
- 4 - Use new lock plates.

#### Note:

From Chassis No. 1 279 013 the lock plates for securing the front shock absorber mounting parts have been replaced by tooth lock washers (shakeproof). At the top, two internal tooth lock washers, at the bottom, one inner and one outer lock washer are used.

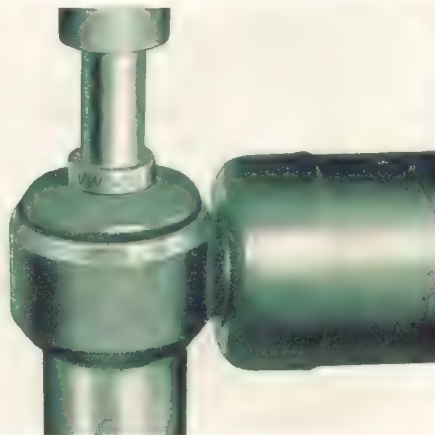
This modification rendered the grooves in the tapped sleeves and lower torsion arm for the lock plate tabs unnecessary.

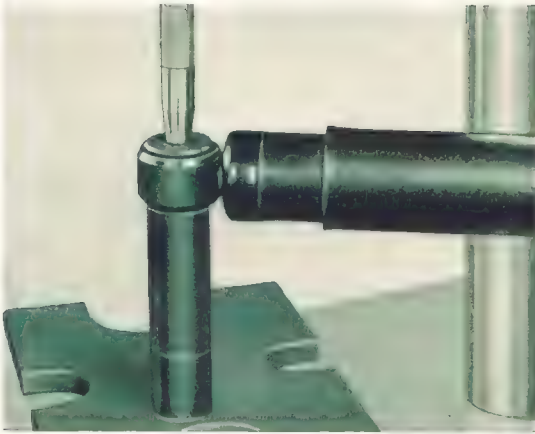
- 5 - Tighten nut and bolt until they are securely bearing against the rubber bearing bushes as otherwise premature wear and rattling during operation will be the result.

## Removing and Installing Shock Absorber Rubber Bearings

### Removal

- 1 - Remove shock absorber.
- 2 - Press out rubber bearing bush on VW Repair Press with guide pin VW 438 in conjunction with VW 401, VW 410 and VW 421.
- 3 - Press out rubber bearing.





### **Installation**

- 1 - Press in rubber bearing.
- 2 - Press in rubber bearing bush with guide pin VW 436 in conjunction with VW 401, VW 410 and VW 421.
- 3 - Install shock absorber.

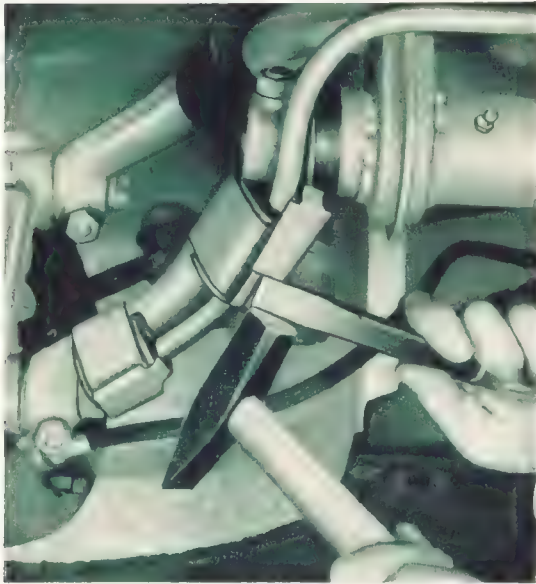


## Stabilizer Shaft Removal and Installation

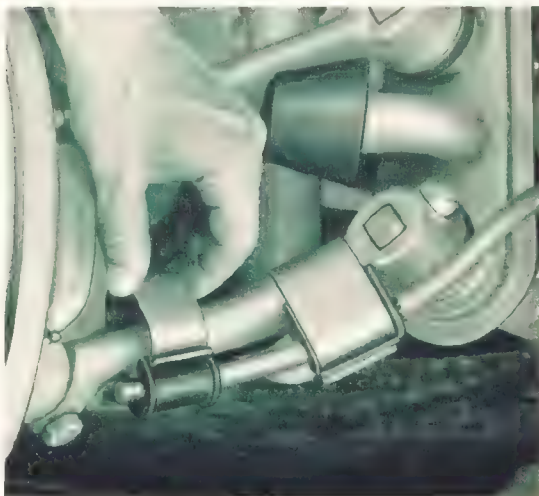
(With front axle installed)

### Removal

- 1 - Remove front wheel outer hub caps and loosen wheel bolts.
- 2 - Lift front end of car and support it on trestles.
- 3 - Remove front wheels.
- 4 - Remove the two clamp links on either side.



- 5 - Expand the clamps and lift them off.

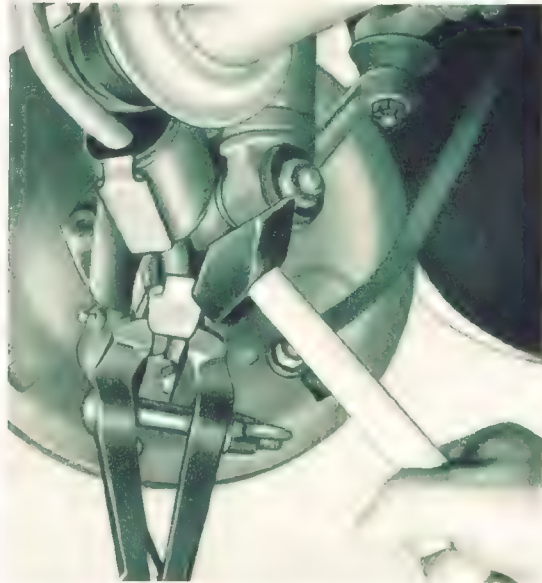


- 6 - Take off stabilizer shaft and slide off the rubber cushions.

### Installation

To install, reverse the preceding operations and observe the following points:

- 1 - Check stabilizer shaft, rubber cushions, clamps, intermediate metal shells and clamp links for damage, replace as found necessary.
- 2 - The clamp edges are tapered. When installing make sure that the edges of both clamps and links taper down toward the wheel.
- 3 - Make sure the inner clamps occupy a position which prevents them from fouling the shock absorbers during operation.
- 4 - Tension the clamps with a tool suitable for that purpose and install the clamp links.



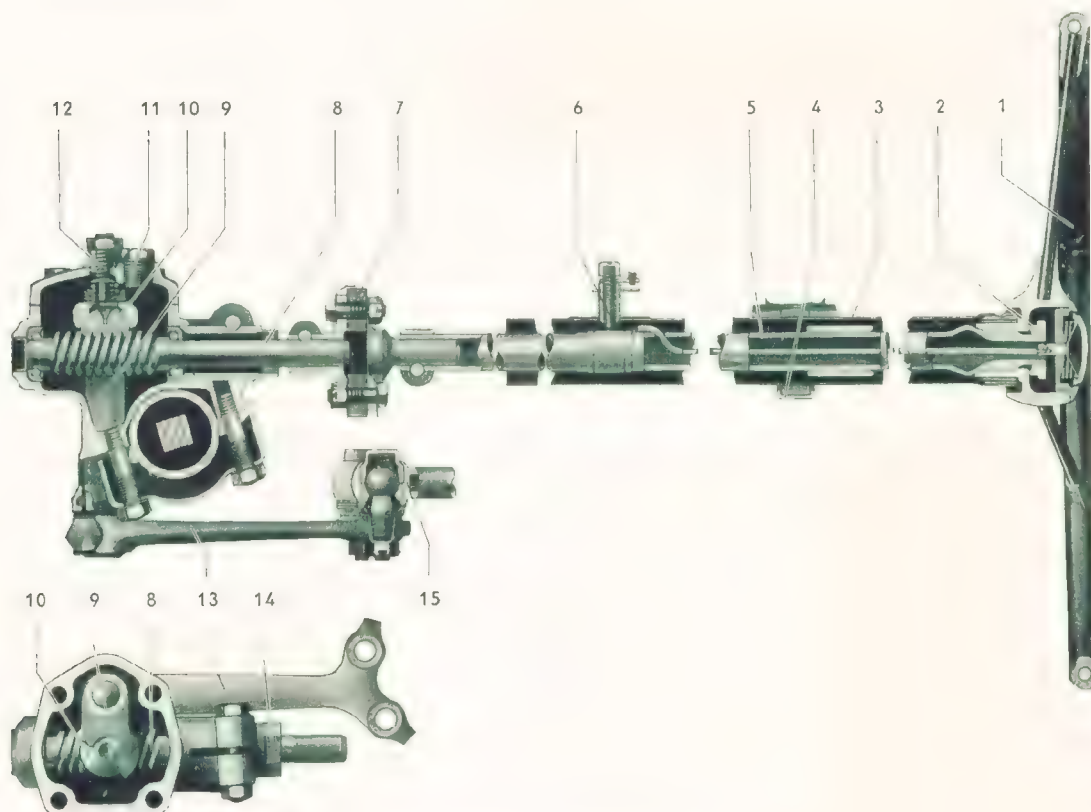
The tongues of the links must always be toward the front axle tubes.

### Note:

To remove the lower front axle mounting bolts, the stabilizer shaft should be slightly pressed downward. This is best be done by placing a wooden block between the upper front axle tube and the stabilizer shaft.

## General Description

The rotation of the steering wheel is transmitted to the steering gear through the inclined steering column and the coupling disc. The adjustable steering worm is carried in ball bearings within the steering gear case which is attached to the upper front axle tube. The hemispherical steering sector is freely located in the concave recess of the sector shaft. Tie (track) rods connected to the end of the drop arm (pitman arm) carry the steering motion to the steering arms at the front wheels.



## Volkswagen Steering

(Sectional View)

- |                          |   |                |
|--------------------------|---|----------------|
| 1 - Steering Wheel       | 8 - Steering Worm                       | } Steering Set |
| 2 - Steering Wheel Nut   | 9 - Sector Shaft                        |                |
| 3 - Steering Column Tube | 10 - Sector                             |                |
| 4 - Retaining Bracket    | 11 - Filler Plug                        |                |
| 5 - Steering Column      | 12 - Adjusting Screw (Radial Clearance) |                |
| 6 - Horn Brush           | 13 - Drop Arm (Pitman Arm)              |                |
| 7 - Coupling Disc        | 14 - Adjusting Sleeve (Axial Clearance) |                |
|                          | 15 - Tie (track) rod joint              |                |

## Lubrication

The steering gear should be lubricated exclusively with transmission oil of the specification SAE 90, under no circumstances with grease or hypoid oil. It is accessible through a hand-opening underneath the spare wheel. The oil level should be checked regularly in accordance with the lubrication chart. The level is to be kept to the lower edge of the threaded hole for the filler plug. An oil change is not required.

The tie (track) rod joints should be lubricated together with the other lubricating points of the front axle at intervals prescribed on the lubrication chart.

## Maintenance

The need for adjustment will be evidenced by excessive free movement of the steering wheel. The play should be kept down to a minimum, but care must be taken to allow the front wheels to resume their straight-ahead position after the car has taken a turn. Regular attention to the adjustment of the steering gear is a point of importance to the function and service life of the steering system.

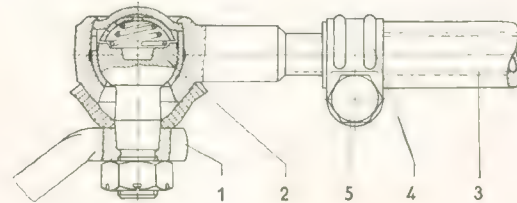
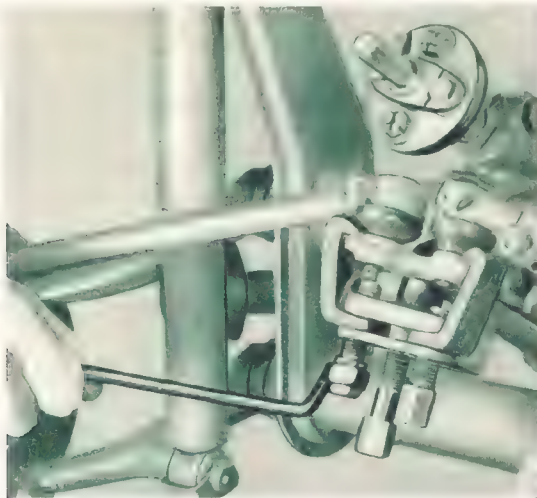
A regular checking of the toe-in ensures a parallel rolling of the front wheels, upholds the good riding qualities of the car and reduces tire wear to a minimum. Steering and toe-in must immediately be checked, if the front axle is suspected to have been affected by an accident.



## Removing and Installing Tie (Track) Rods

### Removal

- 1 - Jack up the car and remove front wheels.
  - 2 - Remove nuts of ball studs.
  - 3 - Press out ball studs by means of special tool VW 266 a.
- Remove tie rods.



- 1 - Steering arm at stub axle (steering knuckle)
- 2 - Tie rod joint
- 3 - Tie rod
- 4 - Clamp
- 5 - Clamp screw and lock washer

- 3 - Damaged or clogged up lubrication fittings should be exchanged; elbow type fittings are to be used at the inner tie rod joints.
- 4 - Install short (with left-hand steering the left) tie rod so that the cranked end is attaching to the steering drop arm.

#### Note:

From Chassis No. 1 430 498 a modification has been carried out on the short left-hand tie rod of VW Sedan and VW Convertible (left-hand drive only).

a - Length of new tie rod:  $354 \pm 1$  mm (previously:  $350 \pm 1$  mm)

b - The slight bend is displaced by 10 mm toward the middle of the tie rod.

As a result of this, the difference in angles between the front wheels when turned  $20^\circ$  to the left and right is nearly equal.

#### Note:

This modification should be taken into consideration when checking steering and front wheel alignment. If necessary the new tie rod can also be installed on earlier cars.

### Installation

This is a direct reversal of the above, but the following points should be observed:

- 1 - Check tie rods for misalignment and damage. Bent or damaged tie rods must in all cases be exchanged in order not to affect driving security.
- 2 - Checks ball studs for wear. Damaged ball studs can be replaced separately, if no complete new tie rod is used. Only re-use ball studs if the threads are not damaged.

#### Note: Karmann Ghia Models only

from Chassis No. 1 644 422, Front Axle No. 1 657 809

- 1 - The short, left-hand tie rod (part no. 141 415 801 A) of the Karmann Ghia Coupé has been modified.

The length of the tie rod is **now**  $347 \pm 1$  mm ( $13.68'' \pm .039''$ ) as against  $349 \pm 1$  mm ( $13.74'' \pm .039''$ ) previously.

As a result of this, the difference in angles between the front wheels when turned  $20^\circ$  to the left and right is nearly equal. It amounts to:

$$2^\circ \pm 30'$$

In the case of the Karmann Ghia Coupé **up to chassis no. 1 644 421**, the difference in the front wheel angularity at  $20^\circ$  is

$$2^\circ \pm 1'$$

- 2 - Left-hand side tie rods of different lengths were used temporarily on the Karmann Ghia Coupé as indicated below:

Chassis No.	Tie rod length
from No. 1 430 498 to 1 605 137	New: $354 \pm 1$ mm ( $13.937'' \pm .039''$ ) Before: $350 \pm 1$ mm ( $13.780'' \pm .039''$ )
from No. 1 605 138 to 1 644 421	New: $349 \pm 1$ mm ( $13.739'' \pm .039''$ ) Before: $354 \pm 1$ mm ( $13.937'' \pm .039''$ )

For replacement: Tie rod, left, part No. 141 415 801 A,  $347 \pm 1$  mm ( $13.68'' \pm .039''$ ) in length.

- 3 - It is important to be familiar with these modifications when checking steering geometry. The specification chart for the EXACTA Optical wheel alignment unit will be altered accordingly.

- 4 - If in the case of the Karmann Ghia Coupé up to chassis No. 1 644 421 inaccuracies in the steering geometry (unpermissible differences in the front wheel angularity) are noticed and if these deviations are not caused by bent or deformed steering arms, all that is necessary is to install the tie rod (part No. 141 415 801 A) of  $347 \pm 1$  mm ( $13.68'' \pm .039''$ ) in length.

The frame head does not have to be reworked nor does the steering gear housing have to be shifted. With the new tie rod, the clearance between steering drop arm and the front end plate of the frame head is  $3-8$  mm ( $.118''-.315''$ ) at full steering lock.

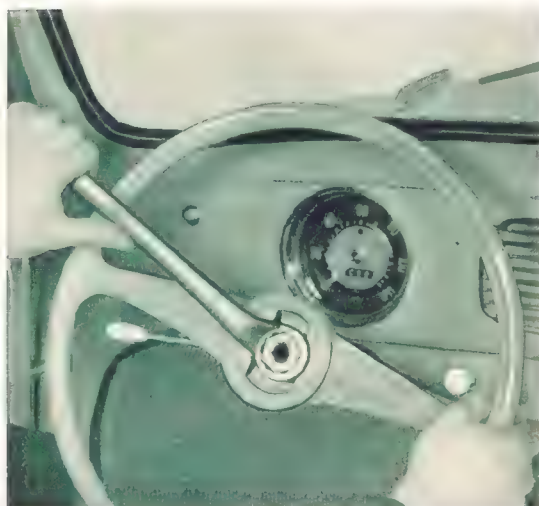
- 5 - Tighten ball stud nuts and check toe-in.

- 6 - Secure nuts with cotter pins and lubricate the joints.

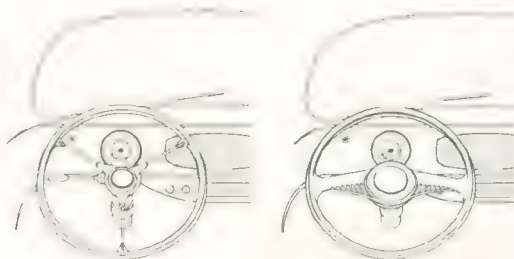
## Removing and Installing Steering Wheel

### Removal

- 1 - Remove horn button.
- 2 - Remove steering wheel nut with box wrench VW 110.
- 3 - Take off steering wheel.



- a) with the three-spoke steering wheel one spoke points downward,
- b) with the two-spoke wheel the two spokes are horizontal ( $\pm 5^\circ$ ) and the profiled portion is towards the driver.



#### Note:

From Chassis No. 1 - 0 929 746 a new steering wheel is installed. This steering wheel can be installed on earlier cars in connection with the horn button (grey-beige), used on the Micro Bus De Luxe.

#### Note:

From Chassis No. 1 320 179 the number of splines in the steering wheel hub has been increased from 24 to 48. This allows an accurate positioning of the steering wheel.

#### Note:

From Body No. 23 000 approx. the Karmann Ghia Coupé is provided with a new two-spoke steering wheel with the hub positioned deeper in relation to the actual wheel (Part No. 141 415 651). A semicircular horn ring (Part No. 141 951 551) is provided in place of the horn button. The steering column (Part No. 141 415 505) has been shortened. The steering column tube (Part No. 111 415 555 B) is of the same length as before but is now positioned further to the front.

Exchange of a steering wheel of previous design for one of new design is only possible together with the new steering column.

### Installation

This is a reversal of the preceding operations, but the following points should be noted:

- 1 - Grease steering column top bush with Universal Grease VW — A 052.
- 2 - With the front wheels in straight-ahead position install steering wheel so that



## Removing and Installing Steering Column

### Removal

- 1 - Remove spring clip at horn sliding contact and pull out brush holder with brush.



- 2 - Remove clamp screw at steering column clamp and remove clamp.

- 3 - Withdraw steering column and steering wheel from steering column tube.

### Installation

This is accomplished by reversing the removal procedure, but the following points should be observed:

- 1 - Check steering column alignment. Permissible run-out: 2 mm (.08").
- 2 - Check steering column top bush for wear. Max. permissible clearance between steering wheel and bush being 0.8 mm (.03"). When exchanging bush, press new bush in position so that it still projects 1 mm (.04") above the steering column tube.
- 3 - Inspect contact ring on steering column for dirt and foreign matter and make sure there is a good contact.
- 4 - Install steering column clamp, using a new lock plate, and tighten clamp screw.

## Removing and Installing Steering Column Tube

### Removal

- 1 - Remove steering wheel.
- 2 - Remove direction indicator (trafficator) switch.
- 3 - Remove spring clip at horn sliding contact and pull out brush holder with brush.
- 4 - Remove bracket at the steering column tube.
- 5 - Withdraw steering column tube from the lower rubber cushion. The tube should be slightly turned when pulling.

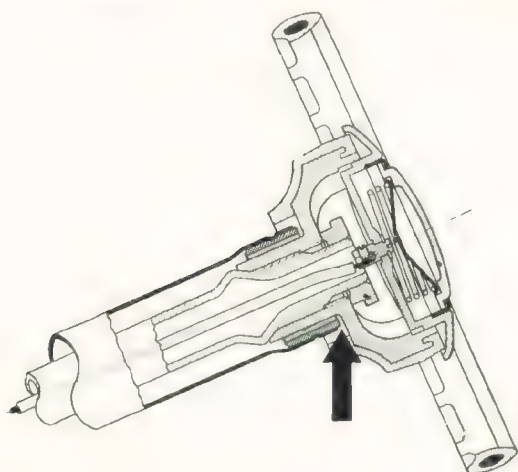




### Installation

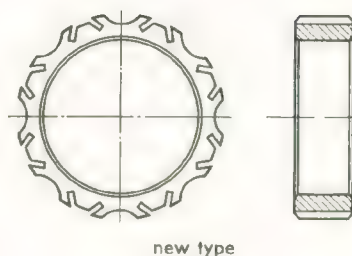
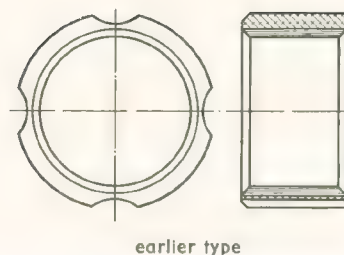
This is accomplished by reversing the preceding operations, but the following points should be noted:

- 1 - Check steering column top bush and grease it with Universal Grease VW — A 052. Worn brushes should be replaced.
- 2 - Inspect upper and lower rubber cushions for damage. Replace them if necessary.
- 3 - Install steering column tube so that there is a sufficient end clearance between the top bush and the recessed face of the steering wheel hub. The steering column must not touch the steering column tube; should this be the case, the position of the steering gear should be corrected.



#### Note:

From Chassis No. 1 084 218 a rubber disc (outer dia. 28 mm/1.10", inner dia. 10 mm/.4") is pushed over the piece of tube that holds the horn brush. This is to avoid draughts occurring between steering column tube and brush tube.



#### Note:

The steering wheel hub has so far been mounted in a hard fiber bush provided with a rubber jacket.

Now all models are provided with a bush made of plastic (Part No. 111 415 581 A) which, with pre-loaded lamellae, firmly bears against the steering column tube. The play has thus been decreased.

Replacement of the bush used previously with that of new design is either possible by shortening the steering column tube to 723 mm (28.5") or by fitting two plastic bushes. If the steering column tube is shortened, it must be displaced towards the rear accordingly.

## Removing and Installing Steering Gear

### Removal

- 1 - Jack up car and support it on trestles. Remove left front wheel.
- 2 - Press out ball studs at steering drop arm (pitman arm), using special tool VW 266 f.
- 3 - Remove clamping screw at the steering column clamp.
- 4 - Remove spring clip at horn sliding contact and pull out brush holder with brush.
- 5 - Withdraw steering column from the coupling flange.
- 6 - Remove steering gear case mounting clamp.



7 - Remove steering gear.

### Installation

While reversing the preceding operations, attention should be paid to the following points:

- 1 - Check and adjust steering gear. If necessary, disassemble steering gear and exchange damaged or worn components. Check seating of steering drop arm (pitman arm) on the sector shaft. The clearance between drop arm and steering gear case must be within 0.4—1.0 mm (.016"—.04"); compensate by shims if necessary.

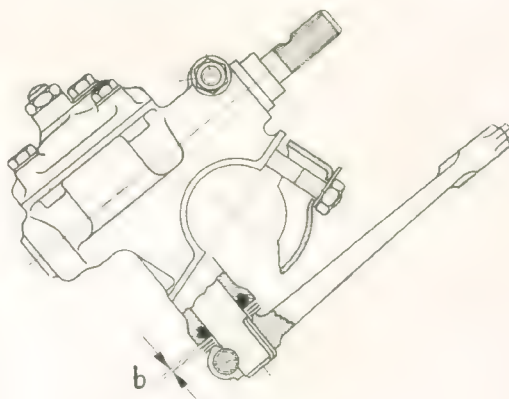
#### Note:

The shims of 0.88 and 2.0 mm thickness (.035" and .08") and a diameter of 28 mm (1.10"), Part Nos.

11 415 171 a and b, between the steering gear case and the steering drop arm have been omitted with effect from Chassis No. 1 - 719 655.

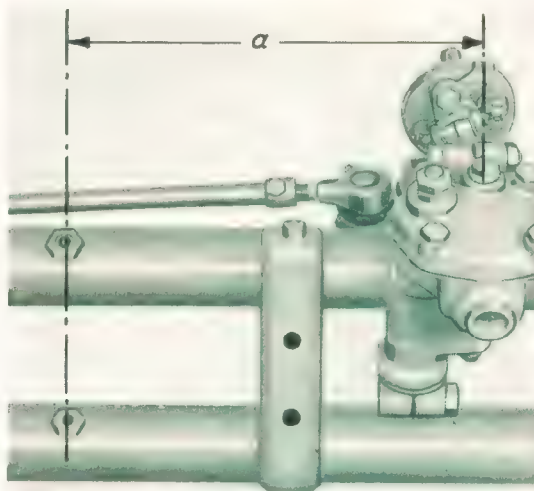
The installation of a light metal steering gear case cover and the reinforcement of this cover by three ribs from Chassis No. 1 - 557 124 onwards rendered the aforementioned shims unnecessary.

The shims are still to be used in conjunction with earlier type steering gear case covers.



$$b = 0.4—1.0 \text{ mm } (.016"—.04")$$

- 2 - Install steering gear case so that the distance from the center of the oil filler plug to the center of the front axle tubes amounts to 260 mm (10.24") and the steering worm shaft is in line with the steering column (at an angle of about 25°). The steering column must not touch the steering column tube.



#### Caution!

In the case of VW Passenger Cars with right-hand drives the distance amounts to 224—226 mm (8.81" to 8.9").

**Note:**

From Chassis No. 1-929 746 onwards, two stops are welded to the upper front axle tube to enable the steering gear case to be mounted in its original position after removal (260 mm/10.24") from center of front axle tubes).

- 3 - Use new lock plates for the two steering gear case mounting clamp nuts.
- 4 - Check oil level; replenish up to the lower

edge of the threaded hole for the filler plug.

- 5 - Check and, if necessary, adjust toe-in.

**Caution!**

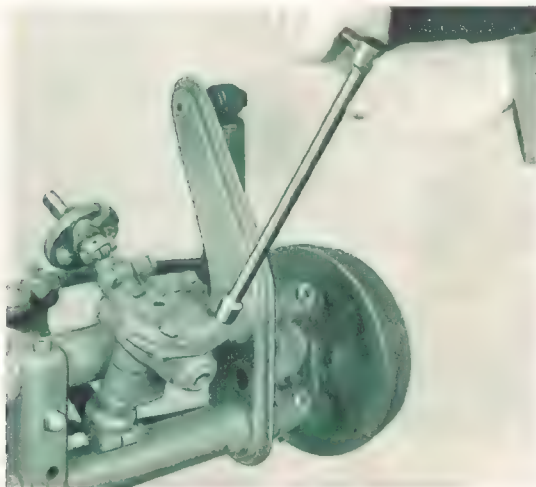
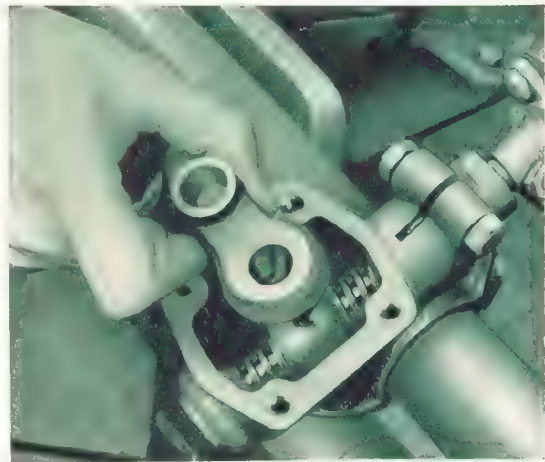
Each time the steering gear has been re-installed, or if the position of the steering gear has been altered, it is absolutely necessary to check the toe-in.

## Disassembly and Assembly of Steering Gear

To facilitate these operations it is recommended to attach the steering gear to a tube having the size of the front axle tube.

**Disassembly**

- 1 - Release clamping screw at steering worm and withdraw complete steering column coupling.
- 2 - Remove bolt that attaches the steering drop arm (pitman arm) to the sector shaft and pull off steering drop arm. Take off shims.
- 3 - Release the four screws of the steering gear case cover and take off cover.

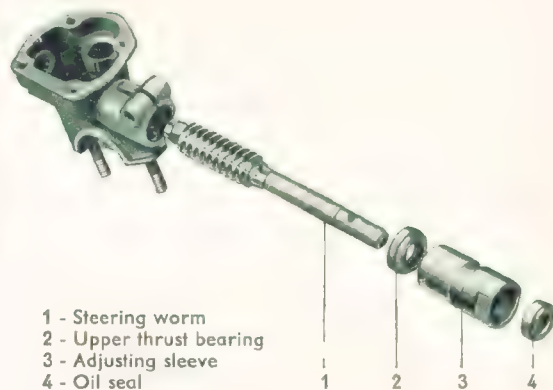


- 4 - Take off thrust pin and spring from sector shaft.
- 5 - Withdraw sector shaft.

- 6 - Take off steering sector.

- 7 - Remove clamping screw at adjusting sleeve.

- 8 - Withdraw steering worm with adjusting sleeve, oil seal and upper thrust bearing.

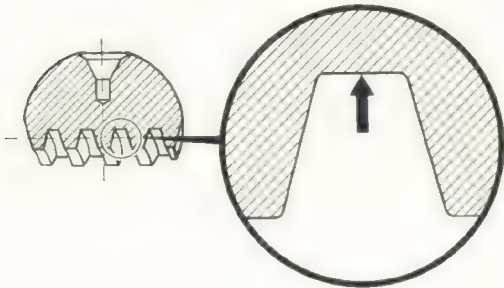




### Assembly

Assembly is effected by reversing the preceding operations, but the following points should be observed:

- 1 - Thoroughly clean steering gear case and components.
- 2 - The thread of the bronze steering sector only bears at the base when new, and the backlash amounts to 0.01—0.02 mm (0.0004"—0.0008").



After some time of service, the backlash will disappear and the thread will also bear at the flanks.

When checking the contact surface, make sure that only a very small amount of engineer's marking (Prussian Blue) is applied.

The contact surfaces for the thrust bearings must be free of damage and not show traces of excessive wear.

Examine seating of sector in its concave recess.

If the concave recess, the steering worm and bronze steering sector show considerable wear or uneven contact, the parts may be replaced separately. However, make sure whether or not it would be better to replace the complete set.

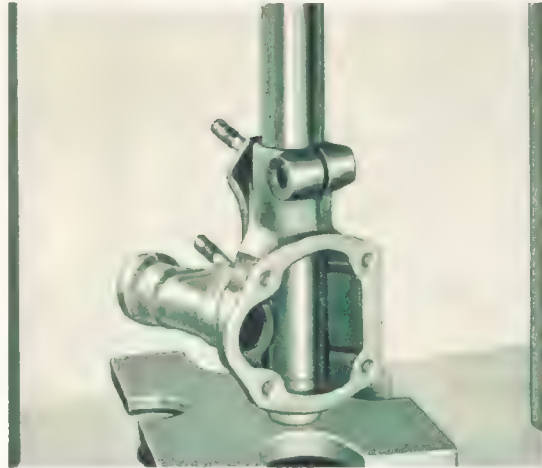
Steering worm and steering sector are no longer lapped together.

On the spare parts side, the three parts are only obtainable in sets.

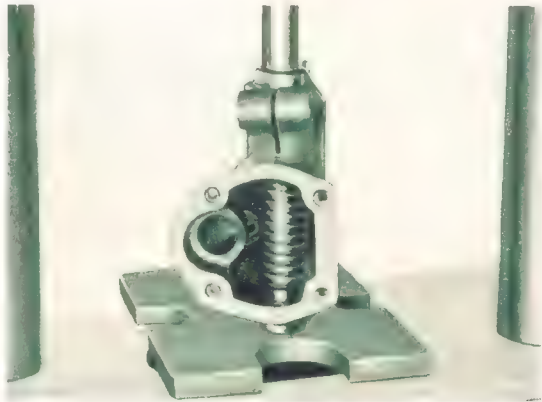
**Attention.** — The new type steering worm and sector (bronze) must not be matched with the corresponding parts of earlier types.

- 3 - Inspect thrust bearings for wear. Install lower bearings on the VW Repair Press, using thrust disc VW 412 in conjunction with VW 401 and VW 417. Never install the bearings by hammer

blows. The thrust surface of the tube VW 417 for pressing in the lower bearing must only contact the outer ring of the bearing.



- 4 - With the steering worm shaft installed, press in upper thrust bearing on the VW Repair Press with tube VW 423 in conjunction with tube VW 412 and VW 401.



- 5 - Examine steering gear case cover gasket and sector shaft oil seal, renew them if necessary.
- 6 - When installing a new felt ring seal for the adjusting sleeve, note that the outer cap ring is inserted first (10—11.5 mm / 0.4"—0.45" deep measured from the upper edge of the adjusting sleeve).

- 7 - Do not turn sector shaft when inserting it in the steering gear case to avoid damaging the seal.

Remove burr at the sector shaft splines prior to inserting the sector shaft. See to it that the contact surface for the lip of the seal is smooth and clean.

- 8 - When installing thrust pin and spring for sector shaft, make sure that they are within the dimensions given below:

$$\text{Spring} = \frac{23.8}{23.0} \text{ mm} \quad \frac{0.94''}{0.90''}$$

Load on  
assembled spring = 60-75 kg. 130-165 lbs.

$$\text{Pin} = \frac{20.1}{19.9} \text{ mm} \quad \frac{0.79''}{0.78''}$$

Thrust pins and springs not within the above limits result in mal-adjustment of the steering and excessive wear of the components.

- 9 - To insure a proper sealing of the steering gear case, sealing compound should be applied as follows:

- a) At stud holes in steering gear case. Additionally, dip stud ends in sealing compound.
- b) Seating surface of end cap at lower thrust bearing.
- c) Steering gear case cover gasket.

- 10 - Fill steering gear case with 125 cu. cm (7.65 cu. ins.) transmission oil SAE 90 (VW—A 002).



## Adjusting Steering Gear

### General Note

The sector shaft end play can be adjusted by means of a screw which also takes up backlash between the worm and the sector. The play must not be in excess of 0.2 mm (0.008").

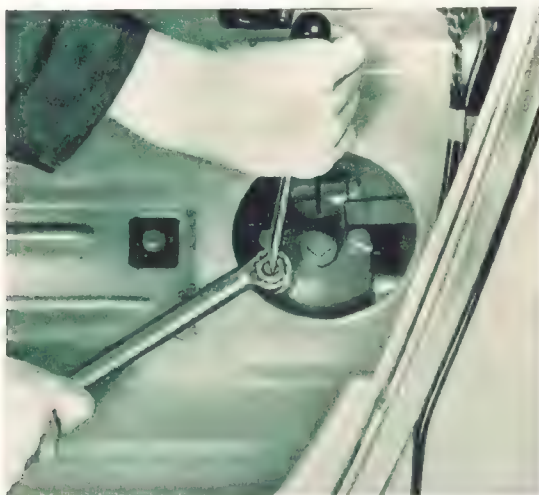
A careful adjustment is absolutely necessary to obtain a proper meshing of the sector with the worm and a good seating of the sector in the sector shaft recess.

This will ensure that wear of the steering components is kept down to a minimum. The play should be kept down to the low limit while taking care that the steering does not bind when turning the steering wheel in both directions as far as it will go. The front wheels should automatically return to the straight-ahead position after having taken a turn.



## Adjustment

- 1 - Loosen lock nut and sector shaft adjusting screw.

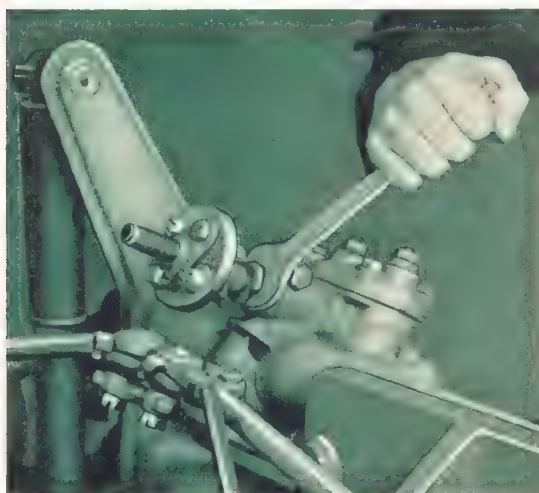


## Worm-Shaft End Play

- 2 - Loosen adjusting sleeve clamping screw and tighten adjusting sleeve clockwise until the worm-shaft end play is taken up.

### Important!

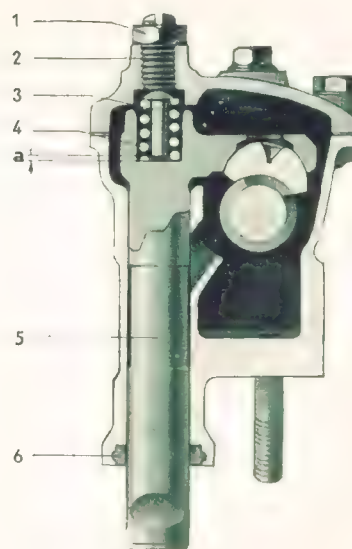
Do not overtighten, as this would damage the worm thrust bearings.



- 3 - Tighten adjusting sleeve clamping screw.

## Sector-Shaft End Play

- 4 - Bring sector shaft arm at right angle with steering worm. Tighten adjusting screw as far as it will go and back it off  $\frac{1}{8}$  turn.



- 1 - Lock nut
- 2 - Adjusting screw
- 3 - Thrust pin
- 4 - Spring
- 5 - Sector shaft
- 6 - Oil seal

$a = \text{max. } 0.2 \text{ mm } (0.008")$

- 5 - Hold adjusting screw and tighten lock nut.

After having completed adjustment with the car supported on trestles, check the steering for binding by turning the steering wheel in both directions as far as it will go.

If a hard steering can be felt, despite the fact that the adjustments have been carried out as described above, the steering gear should be removed and disassembled for checking all the components.





## Steering Trouble Checking

Symptom	Cause	Remedy
<b>Hard Steering</b> Steering is equally stiff from lock to lock, jams or front wheels do not automatically resume straight-ahead position after a turn	<p>a - Front axle inadequately lubricated</p> <p>b - King pins stiff or seized</p> <p>c - Steering gear maladjusted</p> <p>d - Steering sector not matching the steering worm, i.e., the sector does not bear on the root when new, but on the flanks only, allowing it to tilt during operation</p> <p>e - Ball-shaped surface of sector or concave recess in sector shaft damaged</p> <p>f - Sector shaft seized up in bore of steering gear case</p> <p>g - The spring pressure on the sector shaft is too high: Sector shaft end play improperly adjusted, steering sector too large, thrust spring too long or in too much tension Length of thrust pin: 20.1/19.9 mm (.79"/.75") Free length of thrust pin: 23.8/23.0 mm (.94"/.91") Length and load of installed spring: 60—75 kg (132—165 lbs.) 20.3 mm (.91")</p>	<p>a - Jack up front end of car and thoroughly lubricate front axle</p> <p>b - Jack up car and disconnect tie rods. Try to make stiff king pins move freely by thoroughly lubricating them (if necessary with thin oil). If seized, remove king pin and exchange damaged components</p> <p>c - Check steering gear adjustments. Adjust sector shaft and worm shaft end play as prescribed. If necessary, exchange steering set (sector shaft, sector, and worm). Check oil level</p> <p>d - Check impression of contact between steering worm and sector, if necessary replace steering gear set (worm, sector, and sector shaft). In less severe cases, a remedy may be effected by carefully lapping the sector to the worm. To do this, clamp the worm in the chuck of a lathe and use fine grinding compound. Prior to reassembly, remove all traces of the grinding compound and recheck impression of contact</p> <p>e - Renew steering gear set. Check impression of contact before final assembly</p> <p>f - If only slight signs of seizure are evident, these should be carefully removed and the shaft polished. Permissible clearance between shaft and bore: 0.040—0.082 mm (.0016"—.0032")</p> <p>g - Check parts and replace as found necessary. The spring may be ground off so that its end is only 0.9—1.5 mm (.35"—.059") above the thrust pin face in the unloaded condition</p>

Symptom	Cause	Remedy
	h - Steering worm thrust bearing cups damaged, restricting the movement of the balls	h - Check thrust bearings for free movement, replace if necessary. Care should be exercised when pressing the end cover and the upper thrust bearing into the steering gear case. Sealing compound should not enter the lower thrust bearing. The outer edge of the upper thrust bearing cup should be free from burrs in order not to scrape metal chips off the wall of the bore when pressing the cup in position. Such metal chips would enter the lower thrust bearing
Hard steering and squeaking noise	a - Steering wheel binding in steering column top bush  b - Steering wheel hub chafing on steering column top bush face	a - Check position of steering column: if necessary, check and correct position of steering gear (check toe-in). Inspect steering column to bush. Lubricate or exchange as necessary b - Bush too far projecting from steering column tube or steering column tube positioned too high. Lower the tube
Hard steering, unequal resistance and chafing noise	Steering column fouling steering column tube	Alter position of steering gear so that the steering column is correctly centered in the steering column tube (check toe-in)
Front wheels do not resume straight-ahead position after a turn, although there is no binding in the steering system	a - Front wheels improperly adjusted  b - Steering arms of stub axles (steering knuckles) bent or twisted	a - Check and adjust front wheel alignment (caster, camber and toe-in) b - Remove stub axles and check them for bends and twisting with the gauge VW 258a. Replace if necessary
<b>Excessive Play in Steering System</b> Excessive clearance between steering wheel and steering column top bush	Bush worn	Renew bush
Excessive play in steering gear	a - Steering gear improperly adjusted  b - Steering set worn	a - Check steering gear adjustments. Adjust sector shaft and worm shaft end play as prescribed b - Exchange steering set (sector shaft, sector, and worm)
Excessive play in tie rod joints	Ball studs worn	Exchange worn ball studs
Excessive play in front wheel suspension	Worn bearing points (torsion arms, torsion arm links, stub axle, and front wheel bearings)	Check adjustments of torsion arm link pins and front wheel bearings. Renew excessively worn parts



# Front End Geometry



## General Note

The riding qualities of a car largely depend on a proper function of all front axle and steering components. Following are the various interrelated factors that are important in securing easy steering and good road-holding.

- 1 - Proper play in all front axle and steering components and low friction by regularly lubricating.
- 2 - Proper adjustments of front axle and steering.

- 3 - Good front wheel running by proper wheel bearing play and wheel balance.
- 4 - Proper tire pressure and one of the front tires should not be worn more than the other.
- 5 - Correctly acting shock absorbers.

## Note:

Poor road-holding may also be due to rear-wheel tramp, a condition caused by an unequal adjustment of the torsion bars or unequal functioning of the rear shock absorbers.

## Front Wheel Alignment

There must be a certain steering control when riding a car. In accordance with the springing and steering geometry, the following interrelated factors influence car steering control:

- 1 - Camber of front wheels.
- 2 - King pin inclination. This is the inward tilt of the top of the king pin.
- 3 - Caster, formed by the backward tilt of the king pin in line with the car movement and the displacement between king pin and wheel spindle.
- 4 - Toe-in with the front wheels in straight-ahead position.

This angular relationship between the front wheels, the front wheel attaching parts, and the frame secures easy steering and riding qualities.

If one angle is altered by wear or distortion of certain front axle components, the springing and steering geometry is disturbed, even if all the other angles are correct. Misaligned front wheels due to mal-adjustments, excessive wear or bending by a collision may result in:

- 1 - Excessive tire wear.
- 2 - Hard steering.
- 3 - Car wander or car pulling to one side; bad road-holding, especially on wet roads.
- 4 - Front wheel shimmy.

It is, therefore, of utmost importance to check the specified values for camber, toe-in and caster at regular intervals, using accredited test appliances. To know the theoretical background when carrying out inspections and adjustments will, beside practical skill, definitely prove of value.

If advice is required, reference should be made to the Service Department of the Volkswagenwerk.

## Camber and King Pin Inclination

Camber is the outward tilt of the front wheels from the vertical. The wheels are farther apart at the top than at the bottom. King pin inclination refers to the inward tilt of the king pin from the vertical.

Camber and king pin inclination are to insure that the downward thrust of the car weight is at an angle through the stub axle (steering knuckle). The thrust line intersects the center line of the wheel where the tire makes contact with the road. Thus the upper part of the wheel does not tend to move

one way or the other, side thrust on the king pin bearings is reduced to a minimum and steering is accomplished with maximum ease.

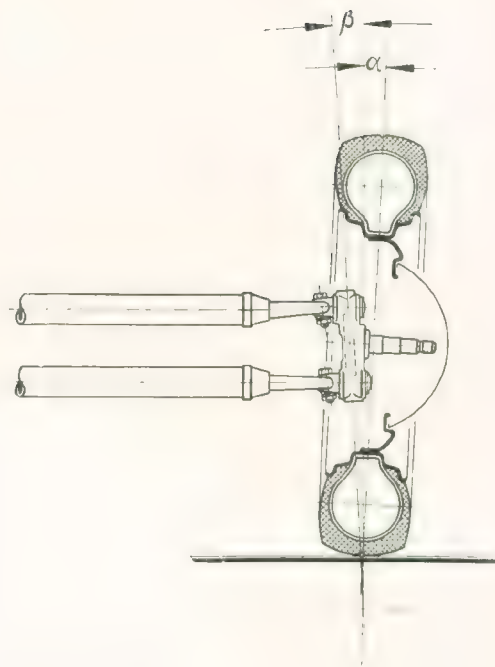
Additionally, the inclined king pin increases the steering stability of the front wheels as it causes the car to be lifted slightly when the steering wheel is turned. The force opposing this upward movement tends to bring the front wheels back to the straight-ahead position as soon as the steering wheel is released after a turn.



Thus the camber is practically lowest with the front wheels in straight-ahead position and increases as the steering wheel is turned due to the inclination of the king pin.

Angle  $\alpha$  = Camber

Angle  $\beta$  = King pin inclination



## Caster

Caster is the backward tilt of the king pin in line with the car movement and the displacement between king pin and wheel spindle.

The center line of the king pin hits the road in front of the point where the tire makes contact with the road. The caster causes the front wheel to be drawn and tends to keep the front wheels straight-ahead, preventing a wandering of the car from side to side.

Angle  $\gamma$  = Caster angle of front axle tubes.

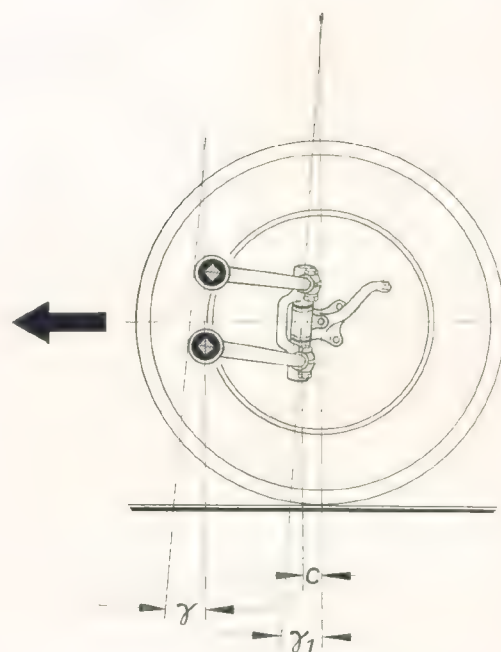
Angle  $\gamma_1$  = Caster angle of king pin.

Distance  $c$  = Displacement between king pin and wheel spindle.

When rounding a curve, the camber of the inner front wheel is larger than the camber of the outer wheel due to the caster position of the king pin.

Too small an amount of caster increases the tendency of the car to give in to side forces (potholes, uneven road surface, side wind).

Too large an amount of caster makes steering difficult as increased force must be applied to turn



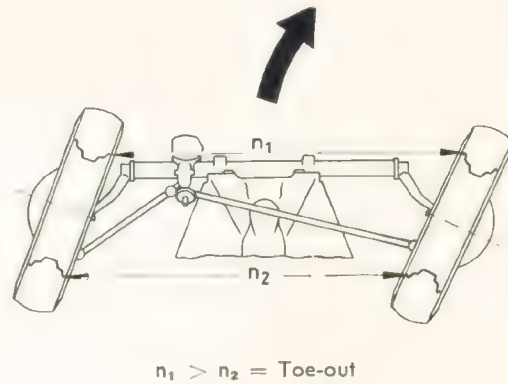
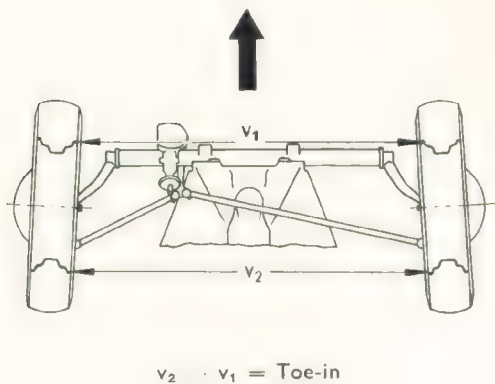
the steering wheel to counteract the tendency of the wheels to remain in the straight-ahead position.



## Toe-in and Toe-out

The camber and the rolling resistance tend to force the front wheels outward at the front. This tendency is compensated by the toe-in, in other words, the front wheels are adjusted to point inward at the front to ensure parallel rolling of the wheels when the car is moving forward.

words, the inner wheel on a curve always toes out more than the outer wheel. Hence, the toe-in decreases when turning the steering wheel and is soon altered into a toe-out, that is, the distance between the front wheels is less at the rear than at the front.



The circles on which the four wheels turn when rounding a curve should have a common center which is on the center line of the rear axle.

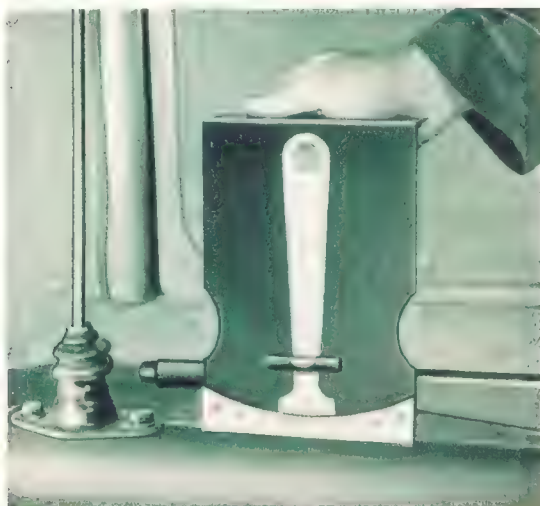
This condition is secured by the proper relationship between the steering arms, tie rods (track rods) and steering drop arm (pitman arm). This relationship permits the inner wheel to follow a shorter radius than the outer wheel, in other

If the proper relationship between the aforementioned steering components is disturbed by incorrect adjustments or distortion, a side slipping occurs at the front wheels, leading to excessive tire wear.

## Preliminary Checks

- 1 - Thoroughly wash underside of car.
- 2 - Check tire inflations.
 

1—2 Occupants	front: 1.1 atm. (16 lbs./sq. in.) rear: 1.4 atm. (20 lbs./sq. in.)
3—4 Occupants	front: 1.2 atm. (16 lbs./sq. in.) rear: 1.6 atm. (23 lbs./sq. in.)
- 3 - Lift front end of car, using front axle hoist VW 318 and check front wheels for wobble or run-out.
- 4 - Check wheel bearing play.
- 5 - Lower the car and place it on a level surface.
- 6 - Check horizontal accuracy of frame by taking two measurements, using a water level or the protractor VW 245 a.
  - a) Place the gauge on the frame tunnel behind the gear shift lever to check the longitudinal level of the frame.
  - b) Place the gauge on the frame tunnel in front of the fork at the rear to check the transverse level of the frame.



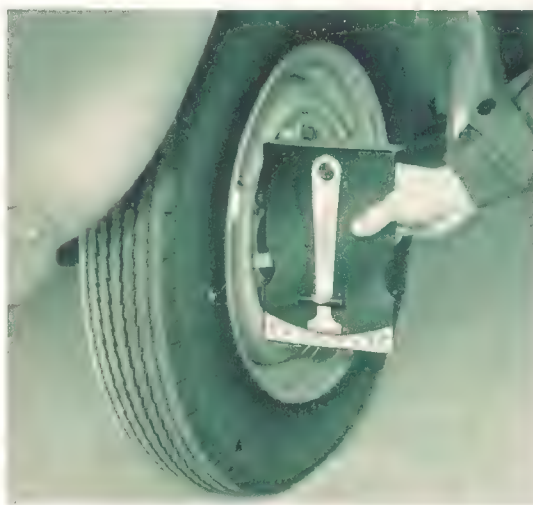
## Checking Camber ( $0^{\circ} 40' \pm 30'$ )

The camber of the front wheels is checked by means of the protractor VW 245 a with the car in an unladen condition. The front wheels should exactly be in the straight-ahead position.

### The camber angle is not adjustable!

Deviations from the specified value may be the result of wear or distortion of front axle components. If deviations are found, proceed as follows:

- 1 - Remove torsion arm link and stub axle (steering knuckle).
- 2 - Check torsion arm link pin bushes and shims for wear, renew if necessary.
- 3 - Check king pins and bushes for wear, renew if necessary.
- 4 - Check stub axle (steering knuckle) with gauge VW 258 a.
- 5 - Check torsion arm link with gauge VW 259 and a depth gauge.
- 6 - Check displacement of torsion arms, using gauge VW 270 a. If the displacement is in excess of the specified limit, the torsion arms



may be twisted and should be checked on test plate VW 282 b.



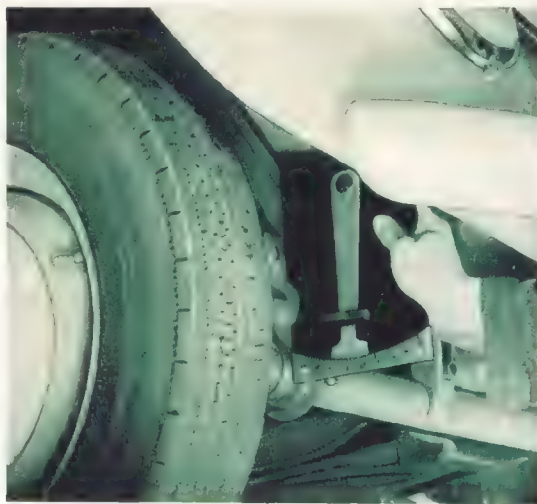
7 - When installing torsion arm link, note proper arrangement of shims. No attempt should be made to correct the camber by altering the arrangements of shims. Deviations from the

proper arrangements cause the torsion arm link pins to become jammed, which would result in premature wear.

## Checking Caster ( $2^{\circ} 30' \pm 30'$ )

To check the caster, only the tilt of the front axle tubes is measured at both ends of the tubes by means of the protractor VW 245 a.

Deviations from the above specified caster angle may be due to the front axle tubes or the frame head being distorted. The adjustment of the rear torsion bars also influences the caster angle of the front wheels and should in this connection be checked.

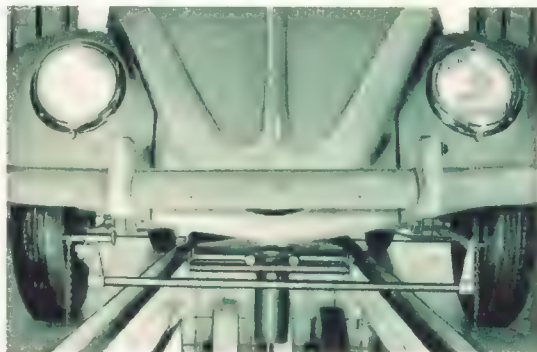


## Checking Toe-in ( $1-3 \text{ mm} = 0.04''-0.12''$ )

The first step in checking toe-in is to make sure that there is no run-out of the front wheels and that wheel bearings, torsion arm link pins and tie rod joints are not excessively worn.

Read the amount of toe-in on the scale. The distance between the front wheels should be  $1-3 \text{ mm}$  ( $0.04''-0.12''$ ) greater at the rear.

- 1 - Set front wheels in straight-ahead position.
- 2 - Place gauge VW 341 c against the wheel rims at height of hub center so that the two chains just touch the ground. Force the two front wheels simultaneously apart at the front to take up any play in the wheel support or steering linkage. Set the scale to zero.
- 3 - Push car forward until the contact points have been turned  $180^{\circ}$  and the two chains just touch the ground.



## Adjusting Toe-in

- 1 - Release clamping screws at both ends of the right tie (track) rod.
- 2 - Adjust toe-in by turning the tie rod until the correct wheel position is reached.
- 3 - Tighten clamping screws and re-check toe-in.



# Tools and Appliances



## 1 - VW Special Service Tools

VW 113	Two Open-end Wrenches, 27 mm
VW 131	King Pin Bush Pilot Drift
VW 133	Torsion Arm Link Pin Bush Pilot Drift
VW 150	Offset Handle
VW 156	Key, 8 mm
VW 202	Extractor
VW 202 c	Extractor Ring
VW 202 d	Extractor Hooks
VW 202 i	Thrust Pad
VW 202 s	Extractor Hooks
VW 217	Facing Cutter
VW 224	King Pin Bush Reamer
VW 244	Driving Sleeve
VW 245 a	Protactor
VW 256 a	Front Axle Tube Alignment Gage
VW 258 a	Stub Axle Gage
VW 259	Torsion Arm Link Gage
VW 266 f	Tie Rod End Remover
VW 270 a	Torsion Arm Offset Gage
VW 273 a	Torsion Arm Bush Drift
VW 274 a	Torsion Arm Bush Reamer
VW 282 b	Torsion Arm Test Plate
VW 308	Stand
VW 309	Holder
VW 400	Repair Press 15 t
VW 401	Thrust Plate
VW 407	Punch
VW 408	Punch
VW 410	Punch
VW 411	Punch
VW 412	Thrust Disc
VW 417	Tube, 30/31.9 mm dia.
VW 418	Tube, 32.5 mm dia.
VW 420	Tube, 28 mm dia.
VW 421	Tube, 28 mm dia.
VW 422	Tube (split)
VW 423	Tube, 21.5 mm dia.
VW 431	Thrust Pad 16.5/28 mm dia.
VW 432	Arbor, 50 mm dia.
VW 433	Thrust Pad
VW 434	Arbor
VW 436	Guide Pin (Tapered)
VW 438	Guide Pin (Cylindrical)
VW 466	Tube
VW 447	Thrust Plate
VW 447 a	Thrust Plate

## 2 - VW Workshop Equipment for Local Manufacture

VW 638	Torsion Arm Bush Driver
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### **3 - Normal Hand Tools**

Screwdriver, 6 mm  
Combination pliers  
Pipe wrench  
Cold chisel  
Prick punch (center punch)  
Mechanic's hammer, 300 grams  
Mechanic's hammer, 500 grams  
Rubber mallet, 85 × 50 mm  
Allen wrench, 8 mm  
Triangular scraper  
Flat file, 180 mm in length  
Open-end wrench, 14 mm  
Open-end wrench, 17 mm  
Open-end wrench, 22 mm  
Box wrench, 14 mm  
Box wrench, 17 mm  
Box wrench, 19 mm  
Wire brush  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl  
Set of feeler gages, 0.1—0.5 mm  
Micrometer caliper, 0—25 mm  
Micrometer caliper, 25—50 mm  
Micrometer caliper, 50—75 mm  
Caliper square, 300 mm in length, measuring 1/50 mm  
Tap M 10  
Tap M 12 × 1.5  
Tap M 16 × 1.5  
Tap M 18 × 1.5  
Die stock, size 2  
Die M 10  
Die M 12 × 1.5  
Die M 18 × 1.5  
Tap wrench, size 1, adjustable  
Tap wrench, size 2, adjustable  
Torque wrench, 0—8 mkg (58 ft. lbs.)  
Drill, 8.5 mm  
Drill, 10.0 mm  
Drill, 10.5 mm  
Drill, 12.0 mm  
Inspection lamp with cable and plug  
Electric drill

### **4 - Supplementary Workshop Equipment**

Special Cutter for Brake Drum Tapped Inserts  
Track (tread) gage  
Wheel Alignment Service Equipment





## Contents:

### **Rear Axle and Synchromesh Transmission**

- 1 - Description of Rear Axle**
- 2 - Removing and Installing Rear Axle**
- 3 - Disassembly and Assembly of Rear Axle**
- 4 - Rear Wheel Bearings and Axle Tubes**
- 5 - Transmission Case**
- 6 - Transmission**
- 7 - Final Drive**
- 8 - Gear Control**
- 9 - Rear Suspension**
- 10 - Special Hints**

### **Rear Axle and Standard Transmission**

- 11 - Description**
- 12 - Transmission Case**
- 13 - Transmission**
- 14 - Special Hints**
  
- 15 - Tools and Appliances**



## General Description

Transmission, rear axle, and engine are combined in the rear of the car. The rear axle is of the swing half axle type. The rubber-cushioned transmission case is secured to the frame at three points. It incorporates the transmission and the differential.

## Transmission Case

The bipartite transmission case is cast of light alloy. It must be clearly understood that when replacements are necessary it is not permissible to replace a single half of the transmission case. They are machined in pairs to very close limits and in consequence replacements must be made in pairs.

## Transmission

The transmission has four speeds forward and one reverse, which is provided with a stop. Synchromesh is obtained with the helical 2nd, 3rd, and 4th gears which are in constant mesh to insure quiet operation.

Gear ratios:

1st	3.60 : 1
2nd	1.88 : 1
3rd	1.22 : 1
top	0.79 : 1
reverse	4.63 : 1

## Gear Control

The shifting rod in the frame tunnel links the transmission to the gearshift lever, which is located on the tunnel beside the driver's seat. Shifting of first and reverse is effected by sliding gears. Synchronizing devices are used in shifting to 2nd, 3rd, and 4th. The synchro-system consists of clutch gear, synchronizer shifting plates, synchronizer stop ring, and operating sleeve.

The operating sleeve is splined to the clutch gear, which in turn is splined to the drive pinion shaft. The synchronizer stop ring is held in position by the three shifting plates which are in slots let into the outer diameter of the clutch gear radially, 120° apart. The first and reverse gear also performs the function of an operating sleeve when shifting to second.

An interlock mechanism is provided to assure positive gear engagement and prevent the selection of more than one pair of gears at a time.

The synchronizer stop rings are provided with internally female coned surfaces which are designed to engage with similar shaped male coned surfaces on the gears. When the operating sleeve is moved towards the gear which is to be engaged, the three shifting plates bring the coned surface of the synchronizer stop ring into contact with the coned face of the gear. The faster moving gear carries the synchronizer stop ring round until the ring is stopped by the shifting plates. This is only a small arcuate movement, bringing the stop ring teeth out of line with the internally cut splines in the operating sleeve. The braking effect, which produces synchronization, takes now place between the two cone surfaces. When exact synchronization of speed is reached, the splines of the operating sleeve engage with the teeth of the synchronizer stop ring and then with the clutch teeth of the gear. This engagement is facilitated by the teeth being chamfered.

To insure a correct operation of the synchro-system, it is of utmost importance to release the clutch completely. The clutch pedal free play should be, therefore, periodically checked. Insufficient declutching or a dragging clutch plate (e. g., by damaged clutch plate lining or distorted clutch plate) lead to rapid wear of the synchronizer stop rings. With the clutch plate completely locked, which may be caused by a broken plate lining, it is not possible to shift gears, as synchronism cannot be reached. Only accredited clutch linings should be used.

Each time an engine has been re-installed in the car, it should be made sure that the clutch fully releases by declutching and shifting into first with the engine running.

More detailed information is given in the section "Clutch".

## Final Drive

Power is transmitted through a helically-cut drive pinion and ring gear (crown wheel), provided with differential bevel gears, via two swinging axles to the rear wheels. Silent operation and a long service life of the final drive mechanism are only insured by carefully adjusting drive pinion and ring gear.

Gear ratios:

Klingelberg toothing .....	4.43 : 1
Gleason toothing .....	4.37 : 1

The differential is to compensate the difference of wheel travel as the car makes a turn, thus maintaining an equal drive of the wheels.

## Rear Suspension

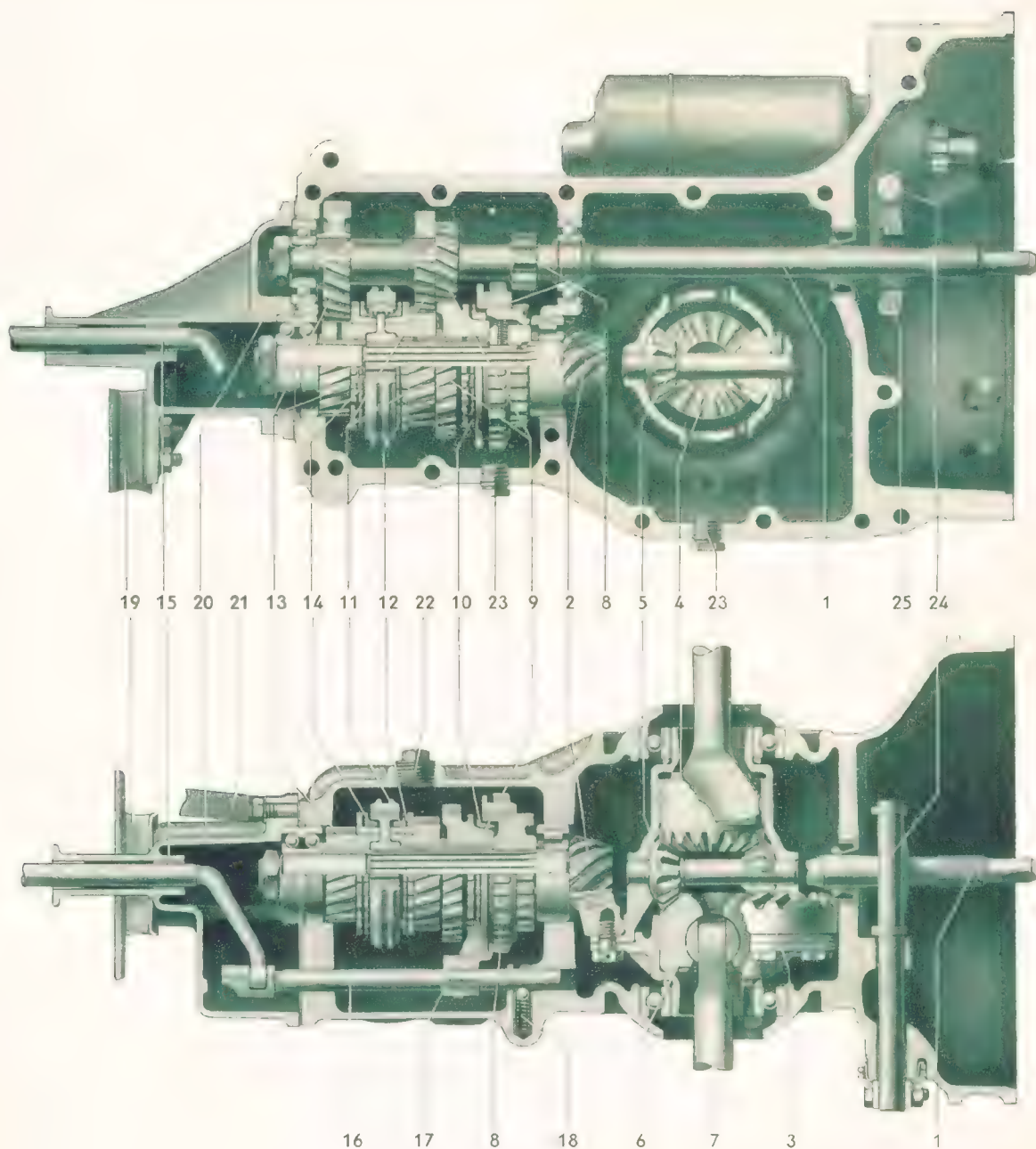
The rear wheels are sprung independently. Road shocks are transmitted to the left or right torsion bar by a spring plate on either side of the rear axle. The torsion bars are anchored in the center of the cross tube and secured against twisting by a spline engagement.

An accurate adjustment of the rear wheel suspension is effected by means of the splines cut in both ends of each torsion bar in different numbers. Hydraulic double-acting shock absorbers of the telescopic design dampen road shocks and prevent excessive rebound.

## Oil Capacity

The oil capacity of the transmission case is 2.3 liters (4.8 U. S. pints; 4 Imp. pints). The oil should be changed at intervals indicated in the Lubrication Chart, using oil of the proper specification. When changing oil, the transmission case should be refilled with 2.0 liters (4.2 U. S. pints; 3.5 Imp. pints).





**Volkswagen — Rear Axle and Transmission**  
(Sectional View)

1 - Main Drive Shaft  
2 - Drive Pinion  
3 - Ring Gear (Crown Wheel)  
4 - Differential Side Gear  
5 - Differential Pinion  
6 - Fulcrum Plate  
7 - Rear Axle Shaft  
8 - 1st Gear Train  
9 - 2nd Gear Train

10 - Synchronizer Stop Ring (2nd Gear)  
11 - 3rd Gear Train  
12 - Synchronizer Stop Ring (3rd Gear)  
13 - 4th Gear Train  
14 - Synchronizer Stop Ring (4th Gear)  
15 - Transmission Shift Rod  
16 - Selector Shaft

17 - Selector Fork  
18 - Detent Spring and Ball  
19 - Front Rubber Cushion  
20 - Gearshift Housing  
21 - Ground Strap  
22 - Oil Filler Plug  
23 - Oil Drain Plug  
24 - Clutch Operating Shaft  
25 - Clutch Release Bearing

## Removal

If it is intended to disassemble the rear axle upon its removal from the vehicle, loosen the axle shaft nuts and the wheel bolts before lifting the vehicle.

- 1 - Disconnect battery ground (earth) cable.
- 2 - Lift car, support it on trestles and remove engine.
- 3 - Remove rear wheels.
- 4 - If the rear axle is to be disassembled afterwards:

Remove axle shaft nuts with Special Wrench VW 112 or with Torque Wrench VW 118/30 in conjunction with Socket VW 163a and withdraw brake drum and oil deflector.

- 5 - Disconnect brake line at rear. Remove brake shoe return springs, brake shoes, brake levers, and brake cable brackets. Withdraw brake cables from back plates.

**Note.** — When exchanging rear axle, the brake cables and brake drums remain on the axle. Unhook brake cables from brake push bar at frame head and withdraw them from the conduit tubes toward the rear. The brake lines between the back plates and the clamps on the rear axle tube should be removed.

- 6 - Remove bolts at rear axle shaft bearing housing.

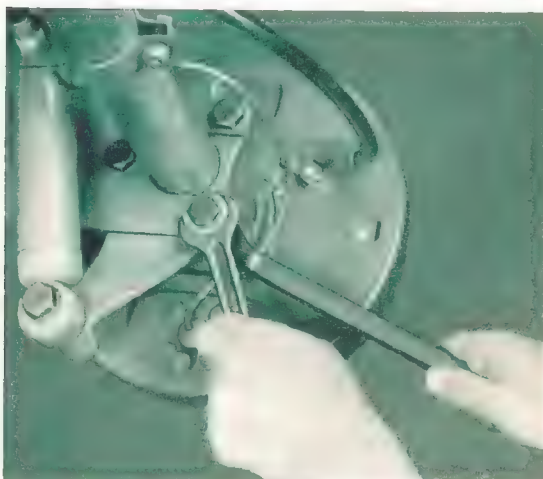
- 7 - Disconnect clutch cable from clutch operating shaft lever and withdraw it from guide plate.

- 8 - Disconnect cables from terminals 30 and 50 at starter motor.

- 9 - Remove frame end cover plate under rear seat. Remove the rear screw of the shifting rod coupling, using T-Wrench VW 114, and move the gearshift lever to withdraw the coupling from the transmission shift rod.

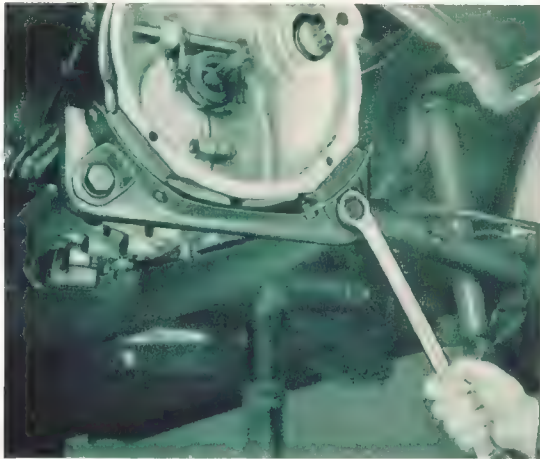


- 10 - Remove nuts at transmission front rubber cushion.

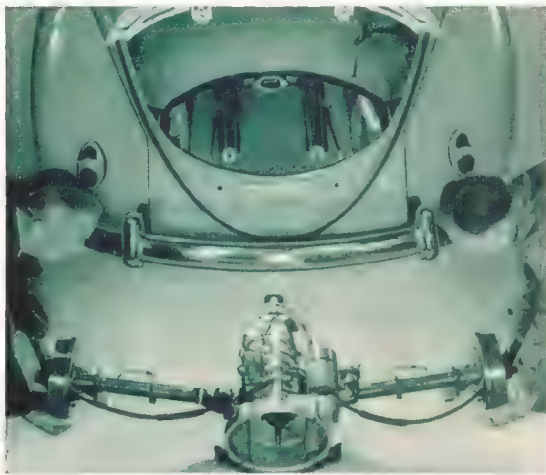




- 11 - Remove the two bolts at transmission carrier, using wrench VW 110.



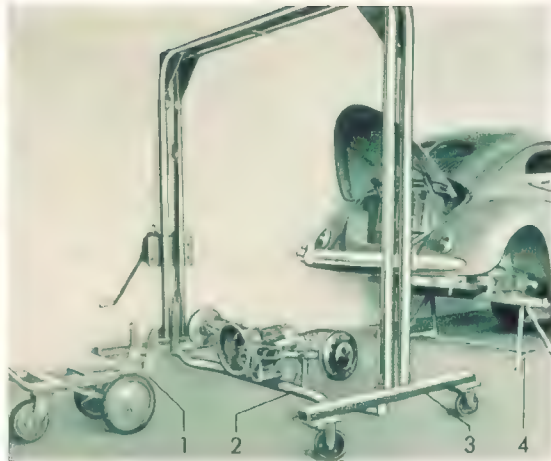
- 12 - Withdraw the axle assembly from the rear of the vehicle.



**Attention!** Take care no to damage the dust sleeves.

#### Note

- a) The removal and installation of the rear axle is facilitated by using the gantry VW 301 (local manufacture) in conjunction with the cross tube. The car is supported on the trestle VW 372a.
- b) When lowering the rear axle, take care the main drive shaft does not strike the floor. Rear axles should be stored on wooden supports to avoid damage.



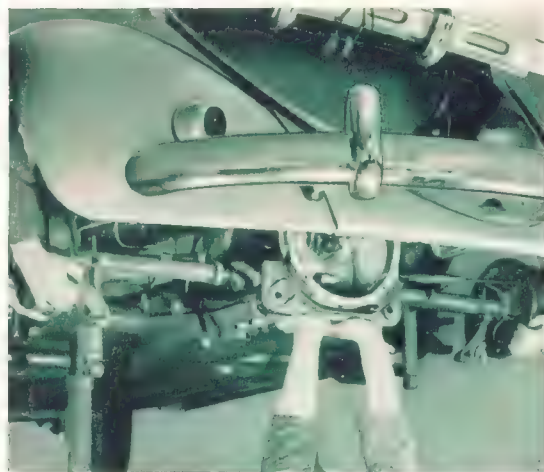
- |                       |             |
|-----------------------|-------------|
| 1 - Transport cart    | 3 - Gantry  |
| 2 - Gantry cross tube | 4 - Trestle |

#### Installation

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

- 1 - Replacing the rear axle between the fork at the frame end can best be carried out by three mechanics.

**Attention!** Take care not to damage the dust sleeves.

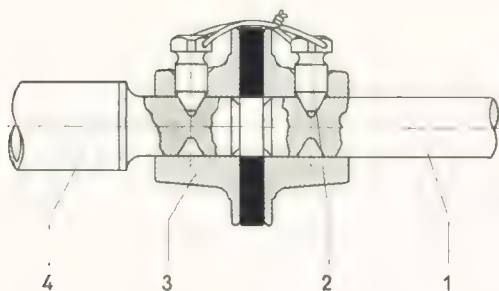


- 2 - Sufficiently grease the two mounting bolts at the transmission carrier.
- 3 - Tighten nuts at transmission front rubber cushion and then tighten nuts of the screws that attach the transmission carrier to the rubber cushions.



This order to tightening the nuts should be strictly followed to avoid distortion and premature wear of the rubber cushions.

- 4 - Make sure that the points of the coupling screws are correctly bedding in their recesses. Secure screws with a piece of wire.



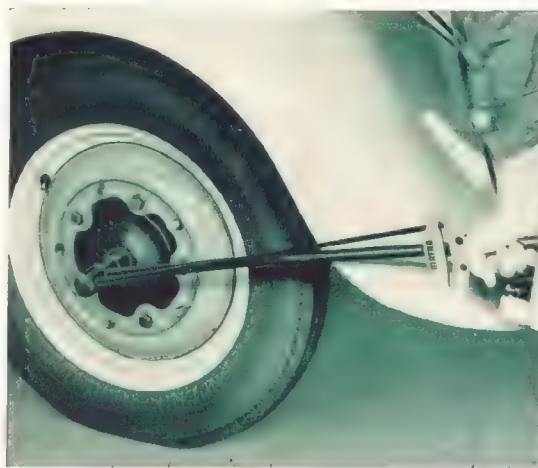
- 1 - Shifting rod  
2 - Coupling  
3 - Screw  
4 - Transmission shift rod

- 5 - When the engine has been replaced, adjust clutch pedal free-play to 10—20 mm (0.4"—0.8").

- 6 - Securely tighten shock absorber nuts.

- 7 - Check splines in hub of brake drum. Renew brake drum if splines are worn or damaged.

- 8 - Tighten rear axle shaft nuts by means of torque wrench VW 118/30 (30 mkg/217 ft. lbs.) and secure them with new cotter pins. The nuts should be tightened after the car has been lowered to the floor.



- 9 - Bleed and adjust brake system.



# Disassembly and Assembly of Rear Axle

# H

It is recommended to adopt the following sequence of operations for the disassembly and assembly of the rear axle:

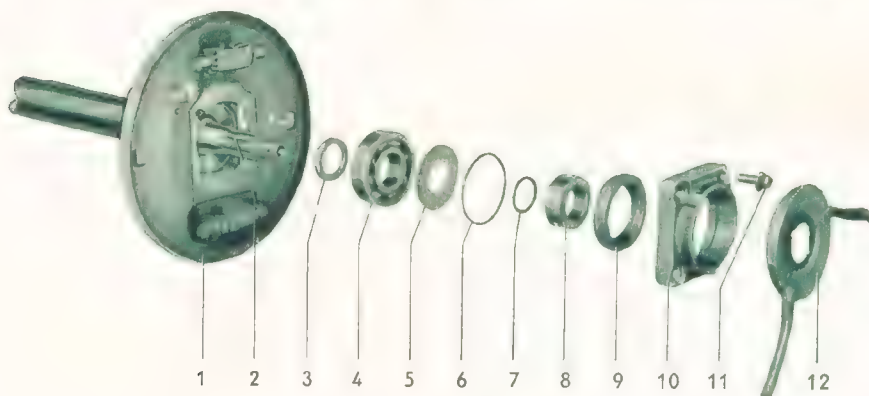
## Disassembly

- 1 - Attach rear axle (left transmission case half) to fixture VW 307 on stand VW 308.
- 2 - Remove both drain plugs.
- 3 - Remove starter motor.
- 4 - Remove transmission carrier.
- 5 - Remove clutch release bearing.
- 6 - Remove axle shaft nuts and withdraw brake drums.
- 7 - Remove brake back plates.
- 8 - Remove rear axle tubes.
- 9 - Remove gearshift housing.
- 10 - Disassemble transmission case.
- 11 - Take off main drive shaft.
- 12 - Take off drive pinion.
- 13 - Remove differential housing and axle shafts.
- 14 - Remove selector shafts, selector forks, and detent balls and springs.
- 15 - Take off reverse sliding gear shaft.

## Assembly

Assembling the rear axle is a reversal of the above operations. Reference should be made, however, to the following pages containing detailed information and special hints as to the correct removal and installation of the individual parts.

## Renewing Oil Seal or Rear Wheel Bearing

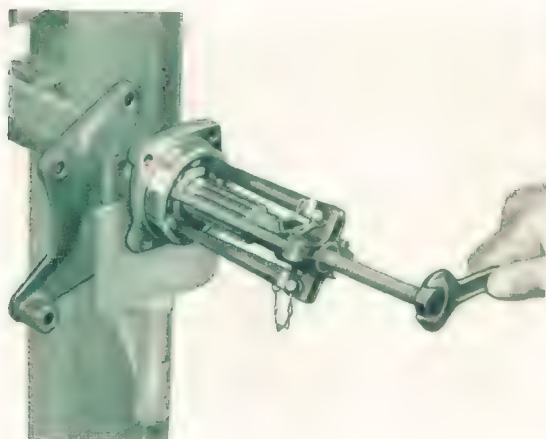


- 1 - Brake back plate
- 2 - Axle shaft
- 3 - Inner spacer
- 4 - Ball bearing
- 5 - Washer
- 6 - Gasket

- 7 - Gasket
- 8 - Outer spacer
- 9 - Oil seal
- 10 - Cover
- 11 - Cover retaining screw
- 12 - Oil deflector

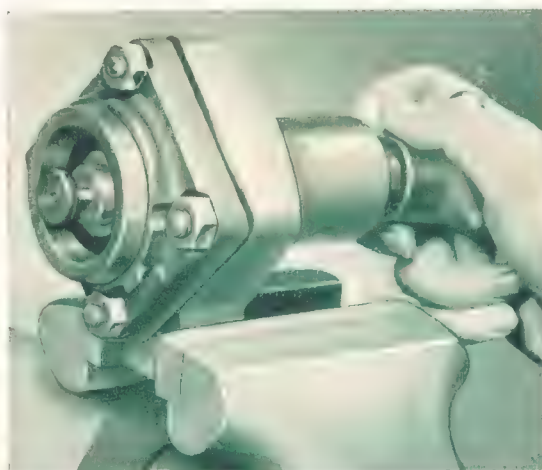
### Removal

- 1 - Remove brake drum and oil deflector.
- 2 - Remove cover retaining screws and take off cover and oil seal.
- 3 - Remove brake back plate.
- 4 - Take off outer spacer, gasket between spacer and ball bearing, washer, and cover gasket.
- 5 - Remove rear wheel bearing, using extractor VW 241 T and take off inner spacer.



### Removing and Installing Oil Seal

- 1 - If the oil seal lip is uneven or damaged, the oil seal should be removed from the cover by means of the tool VW 230.



- 2 - Lightly coat new oil seal with oil and press it in position, using tool VW 230 or Repair Press VW 400 in conjunction with VW 401, 408, 441, 442, and 443 or 444.

The seating depth is between 4.7 and 5.0 mm (0.185" and 0.197").



3 - Check if oil seal beds squarely in the cover by using the gauge VW230a/3. The depth is measured from the ball bearing contact face in the cover. A tilted oil seal is in nearly all cases responsible for oil leaks.



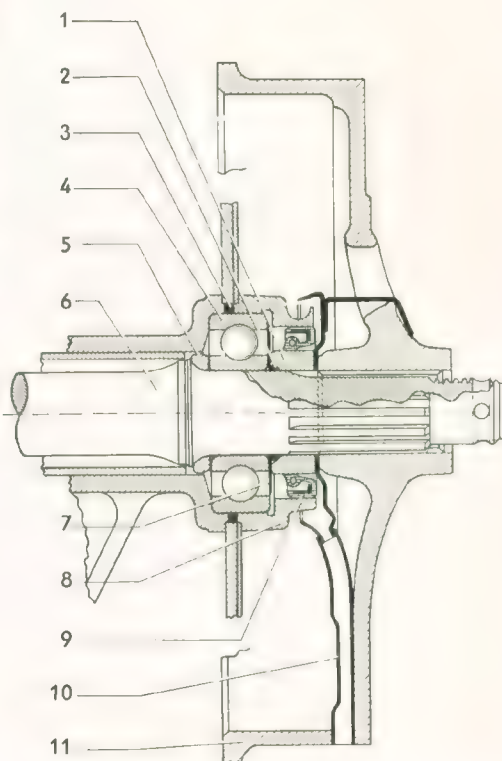
#### Installation

- 1 - Examine condition of ball bearing, renew if worn or damaged.
- 2 - Renew the two gaskets.
- 3 - Replace cover so that the oil drip nose points downwards.



4 - The spacer must not be scored, cracked nor show signs of rust. To avoid damage to the oil seal lip by friction, the spacer should be lightly coated with oil. Make sure that all components to be fitted are absolutely clean.

5 - Clean the oil deflector before reinstalling it. Make sure that the oil drip tube is tightly bearing against the brake drum to prevent it fouling the brake shoes.



- |                  |                    |
|------------------|--------------------|
| 1 - Outer spacer | 7 - Washer         |
| 2 - Gasket       | 8 - Bearing cover  |
| 3 - Gasket       | 9 - Oil seal       |
| 4 - Ball bearing | 10 - Oil deflector |
| 5 - Inner spacer | 11 - Brake drum    |
| 6 - Axle shaft   |                    |

6 - Check splines in brake drum hub. Replace brake drum if splines are worn.

7 - Tighten rear axle shaft nut with VW 118/30 and VW 163 a (28—31 mkg/202—224 ft. lbs.) and secure it with a cotter pin.

## Removing and Installing Rear Axle Tube

### Removal

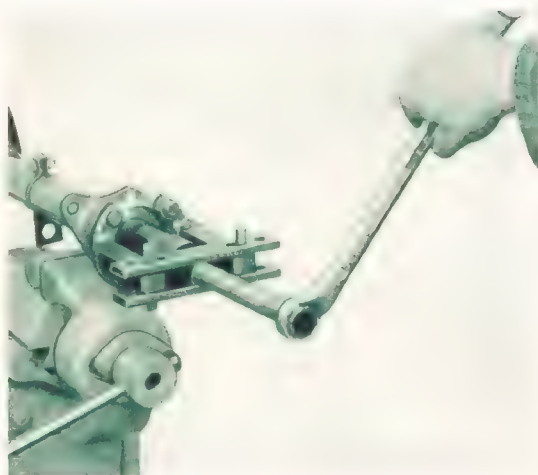
- 1 - Remove brake drum and brake back plate.  
Pull off rear wheel ball bearing.
- 2 - Remove nuts holding axle tube retainer.



- 3 - Take off rear axle tube, retainer, and gasket.
- 4 - Drive out lock pin in axle shaft bearing housing.



- 5 - Remove bearing housing from axle tube by using extractor VW 202 in conjunction with VW 202b and VW 202h or Repair Press VW 400 in conjunction with VW 407 and VW 401.



### Note:

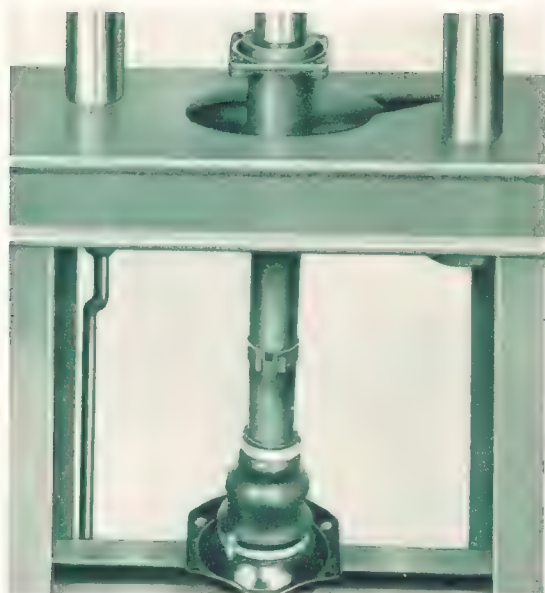
Bearing housings become generally bent or damaged when removing them in an unskilled manner and tend to crack when attempting to straighten them. Damaged bearing housings should not be reused.

- 6 - Take off brake cable retaining ring (rubber).
- 7 - Release dust sleeve clips and withdraw dust sleeve and axle tube retainer from axle tube.

### Installation

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

- 1 - Clean axle tube retainer and axle tube retainer seat on transmission case.
- 2 - Check convex axle tube seating surface on transmission case for wear. If burr is present, remove it with a scraper.
- 3 - Examine dust sleeve; renew if damage is apparent.
- 4 - Install brake cable retaining ring (rubber).
- 5 - Inspect axle shaft bearing housing; renew it if damage is apparent. Before pressing the housing in place, thoroughly clean all seating surfaces and oil both, housing and axle tube. Press the housing in place by using Repair Press VW 400 in conjunction with VW 407 and VW 433. With the axle tube in position, the bearing housing should be installed with the drift VW 240a.



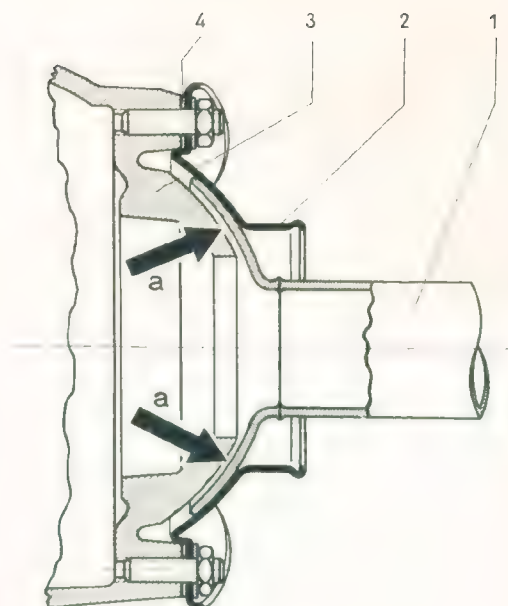
6 - Check end play of axle tube (0.40—0.60 mm / 0.016"—0.024"). If the wear limit of 0.7 mm (0.027") is exceeded (source of noise), the prescribed play can be restored as follows:

The oil resistant paper gasket (0.25—0.30 mm / 0.01"—0.012") under the axle tube retainer should be removed or replaced by another one of 0.1—0.15 mm (0.004"—0.006"). If no paper gasket is fitted, the axle tube retainer must be coated with sealing compound.

**Note:**

The above described reduction of the axle tube end play can also be carried out with the rear axle in situ.

7 - Tighten dust sleeve clips not before the rear axle is installed to prevent the dust sleeve from becoming twisted and eventually damaged.



$a = \text{max. } 0.7 \text{ mm } (0.028'')$

- 1 - Rear axle tube
- 2 - Rear axle tube retainer
- 3 - Transmission case
- 4 - Gasket

**Note:**

During the period from the end of March to the beginning of October 1957, from Chassis No. 1 673 351 rear axle tubes were fitted in a number of cases which were not ground at the bearing flange seat but were in an unmachined condition.

If on occasion of repairs an unmachined axle tube is to be replaced by a ground tube, a new bearing flange has to be used in conjunction with the ground tube.

The two rear axle tubes can be easily identified. Only ground tubes, spare part number 111 501 105, are supplied as spares.

Due to a modification in the design of the bearing flange, ring gauge VW 433a has to be used, in addition to pressure plate VW 433, when pressing the bearing flange on the axle tube. Only thus can a proper seat be ensured between the flange bore for the dowel pin and the flat section of the rear axle tube.

With the rear axle installed, mandrel VW 204a can be used on the bearing flange.



## Renewing Rear Axle Dust Sleeve

(With rear axle in place)

To avoid a removal or disassembly of the rear axle when renewing a damaged dust sleeve, a split dust sleeve is available.

### Removal

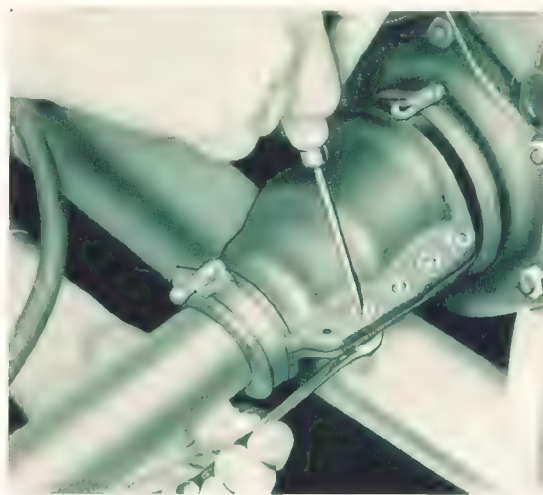
- 1 - Remove both retaining clips.
- 2 - Cut and remove the dust sleeve.
- 3 - Clean axle tube and axle tube retainer.

### Installation

- 1 - Slightly coat jointing faces of the split dust sleeve with elastic sealing compound (VW Sealing Compound D 1 a).
- 2 - The flange of the split dust sleeve should point horizontally towards the rear. Tighten screws.
- 3 - Tighten retaining clips (9 mm/0.35").

### Important!

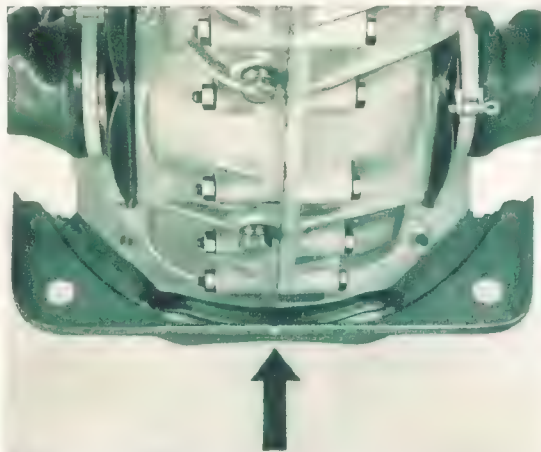
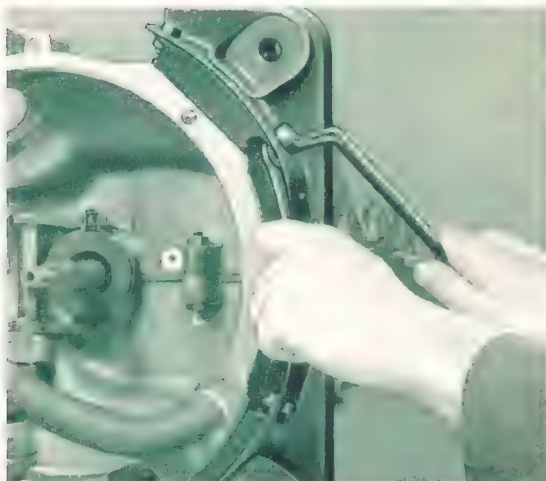
The dust sleeve screws and retaining clips should not be overtightened. Tightening should be done with the rear axle in loaded condition. Take care the dust sleeve is not twisted or strained.



## Removal and Installation of Transmission Carrier

### Removal

- 1 - Remove the four screws that attach the transmission carrier to the rubber cushions.



### Important!

An incorrectly mounted transmission carrier (note center mark) is responsible for an incorrect position of transmission and engine, leading to difficult gearshifting and insufficient sealing of engine compartment against road dust.

- 2 - Withdraw transmission carrier.

- 3 - The removal of the two rubber cushions is only necessary when completely disassembling the rear axle. It is recommended to remove them not before the transmission case is opened.

### Note:

The following modifications on the transmission mounting cushions were introduced with Chassis No. 1—0713985 to improve the sound insulation of the body:

- 1 - Front rubber cushion:  
Softer than before.
- 2 - Rear rubber cushion:  
Harder than before.

### Installation

Installation is a reversal of the preceding operations, but the following points should be heeded:

- 1 - Inspect rubber cushions for damage.
- 2 - Attach transmission carrier to rubber cushions. The nuts should, however, not be tightened before the transmission is installed and the nuts of the front rubber cushion are tightened. Care should be taken that the center mark on the carrier is in line with the transmission jointing faces.

### Hints for subsequent installation

- a - The altered parts are marked by a yellow paint line. Additionally, an "A" is indented in the rubber or raised.
- b - Always a complete set (one front and two rear rubber cushions) should be used. The installation of old and new type rubber cushions in one car involves disadvantages.
- c - After the altered rubber cushions have been installed, make sure that the clutch cable guide tube bends down at least 30 mm (1.2"). This tension of the guide tube is obtained by inserting washers Part No. 11513399 between the bracket at the transmission and the end piece of the guide tube.

# Removing and Installing Gearshift Housing

## Removal

- 1 - Remove nuts that attach the rubber cushion to the gearshift housing.

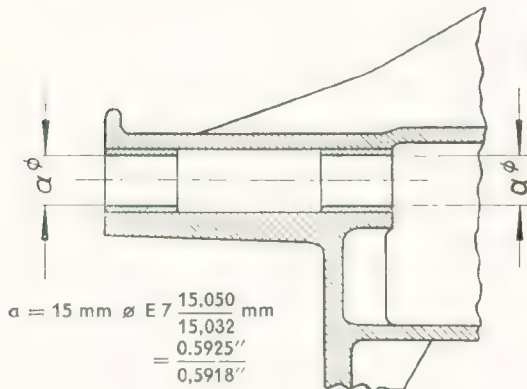


- 2 - Remove gearshift housing nuts and take off ground strap.
- 3 - Take off gearshift housing and transmission shift lever.
- 4 - Remove gasket and clean jointing faces.

## Installation

This is accomplished by reversing the removal procedure, but the following hints should be observed:

- 1 - Inspect transmission shift lever bushes. Worn bushes must be replaced by using the Repair Press VW 400 in conjunction with VW 401, 412, and 439. The bushes are to be reamed up to  $\frac{15.050}{15.032} \text{ mm} = \frac{0.5925''}{0.5918''}$ .



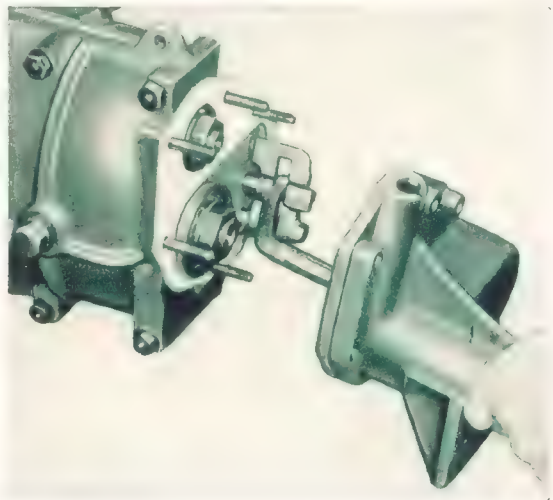
## Note:

From Chassis No. 1—0881293 onwards, one transmission shift lever is used for both synchromesh and standard transmissions in lieu of the two different levers.

If necessary, the new transmission shift lever can be subsequently installed in synchromesh and standard transmissions built after January 1953 — approx. from Chassis No. 1—0428157 onwards. The gearshift housing of these transmission has its inner edges chamfered in a way which allows proper gearshifting with the new lever. The new lever does not allow a proper engagement of the reverse when installed in transmissions built before Dec. 1952.

For earlier standard transmissions, the transmission shift lever, is still available as a spare part. Should it become necessary to replace levers of synchromesh transmissions built during the period from October 1952 (introduction of synchromesh) to December 1952, this should be done in conjunction with the corresponding gearshift housings.

- 2 - Note thicknesses of gasket and paper ring between gearshift housing and transmission case to insure that the ball bearings are correctly preloaded. Excessively preloaded ball bearings may cause noise and premature wear. Only use gaskets which cover the hole for the reverse sliding gear shaft.
- 3 - Make sure the three selector shafts are in neutral position when attaching the gearshift housing.



- 4 - Connect ground strap to the correct stud.



## Preload of Transmission Ball Bearings

### General

The assembly of the transmission case necessitates a careful consideration of the preload on the drive pinion double row bearing and the main drive shaft front bearing.

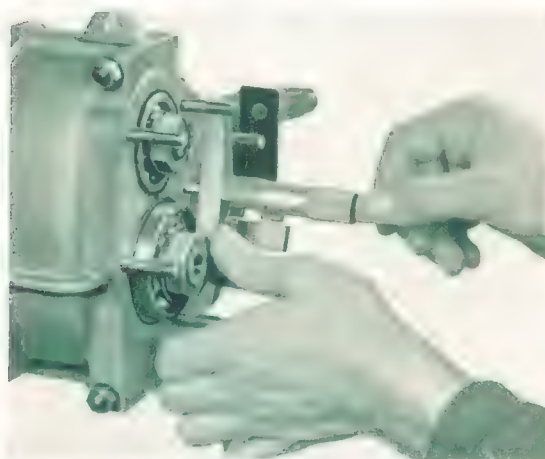
The gearshift housing is tightened in position to a preload of between 0.02 and 0.11 mm (0.0008" and 0.0043"). The preload is obtained by the correct selection of the gasket or paper ring.

### How to Determine Preload

Before measuring, any end play of the drive pinion and main drive shaft should be eliminated by light taps with a mallet. The measuring should, if possible, be done with a depth micrometer.

The following dimensions should be checked:

- a - Dimension D, distance from matching face of transmission case to drive pinion bearing face.



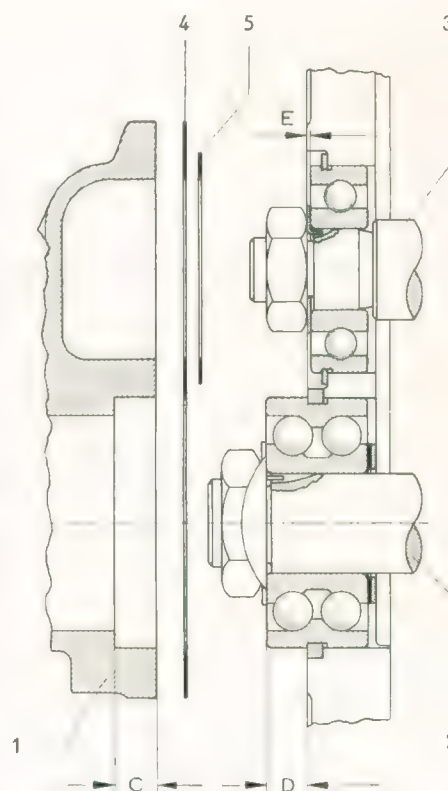
Dimension C, depth of recess for drive pinion bearing in gearshift housing.

The difference between D and C is to be compensated by the selective fitting of the gasket and paper ring to insure the prescribed preload (0.02—0.11 mm/0.0008"—0.0043") on the double row ball bearing.

- b - Dimension E, distance from matching face of transmission case to main drive shaft bearing face.

This bearing must be subject to the same preload as the double row ball bearing. A selection of paper rings (5) is available to correct the preload on the main drive shaft bearing.

These rings are to be glued to the gasket (4), taking care that they are concentric with the ball bearing.



- 1 - Gearshift housing
- 2 - Drive pinion
- 3 - Main drive shaft
- 4 - Gasket
- 5 - Paper ring

C - Depth of recess for double row ball bearing in gearshift housing.

D - Distance from transmission case matching face to double row ball bearing face.

E - Distance from transmission case matching face to main drive shaft ball bearing face.

**Example:**

a - Dimension D .....	10.50 mm
Dimension C .....	10.25 mm
Difference .....	0.25 mm
Dimension for preload .....	— 0.05 mm
Thickness of gasket .....	0.20 mm

b - Dimension E .....	0.14 mm
Preload on main drive shaft ball bearing .....	+ 0.06 mm
Thickness of paper ring .....	0.20 mm

## Disassembly and Assembly of Transmission Case

The two transmission case halves are machined in pairs to very close limits and in consequence replacements must be made in pairs. It is not necessary to replace the gearshift housing together with the transmission case. After the matching faces have been cleaned, they must be lightly coated with sealing compound. A replacement of the transmission case necessitates a readjustment of the preload on the differential ball bearings by a selective fitting of shims.

**Note:**

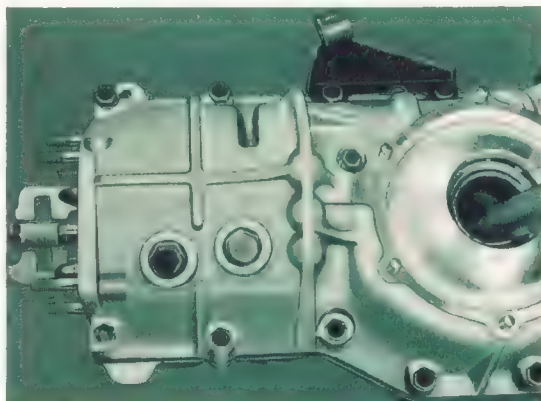
The Rear Axle Number is stamped on the right transmission case half at the gearshift housing jointing face.

**Disassembly**

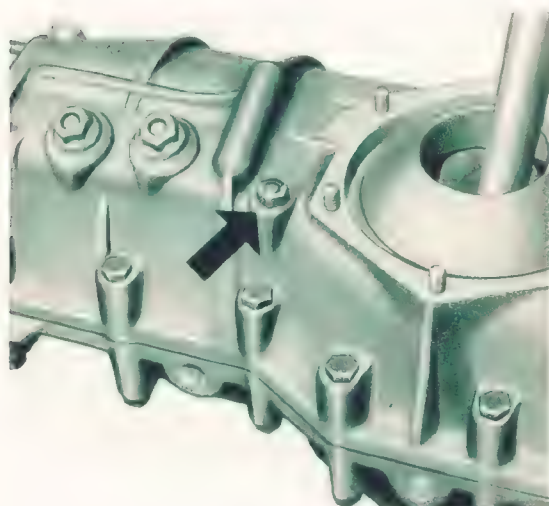
- 1 - Remove gearshift housing.
- 2 - Remove clutch release bearing and disconnect clutch operating lever return spring.
- 3 - Remove screws at transmission case matching faces. Remove the nut on the stud situated at the left transmission case half near the axle tube retainer.

**Note:**

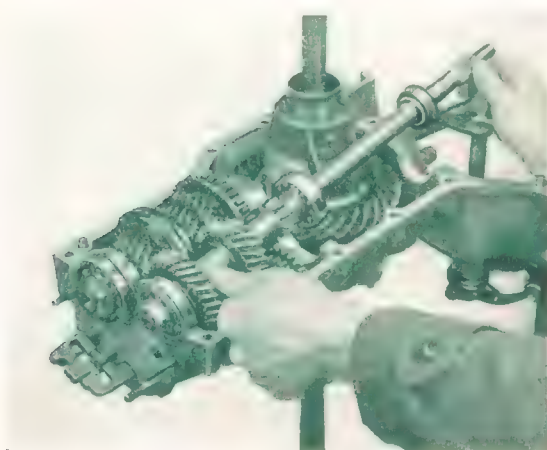
From Chassis No. 1600440 the stud near the axle tube retainer has been discarded and is replaced by a protruding bolt. Due to the smaller diameter of the needle bearings for drive pinion and drive shaft the bolt could be housed in the web between bearings.



- 4 - Turn the transmission case and take off right transmission case half, taking care not to damage the jointing faces.



- 5 - Remove complete main drive shaft and drive pinion from left transmission case half.



- 9 - Remove plug screws from the holes which give access to the selector fork locking screws.

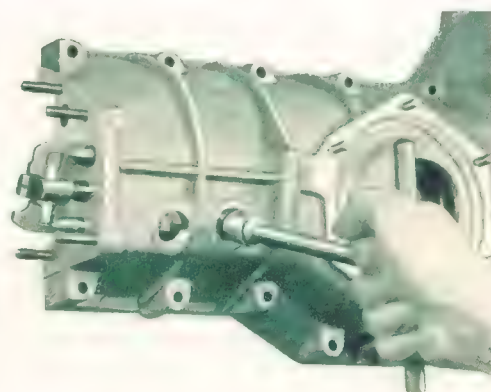
- 6 - Drive out differential and rear axle shafts from the left transmission case half by means of a mallet. Note arrangement of the differential shims to assure proper installation at assembly.



- 7 - Remove lock pin at reverse sliding gear shaft.



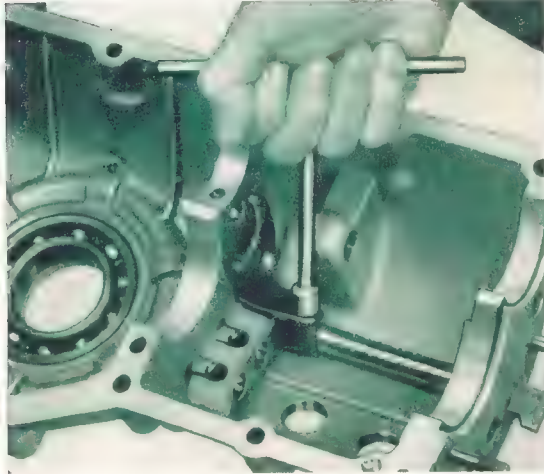
- 10 - Loosen locking screws of first-and-second selector fork and third-and-fourth selector fork, using hex. socket wrench 11 mm.



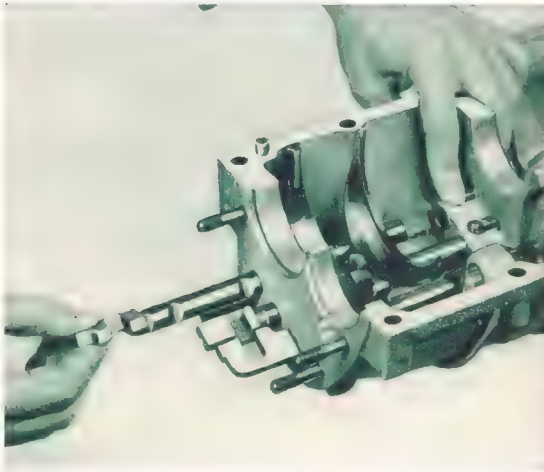
- 8 - Drive out reverse sliding gear shaft and remove reverse sliding gear.



- 11 - Remove locking screw of reverse selector fork, using T-wrench VW 114.



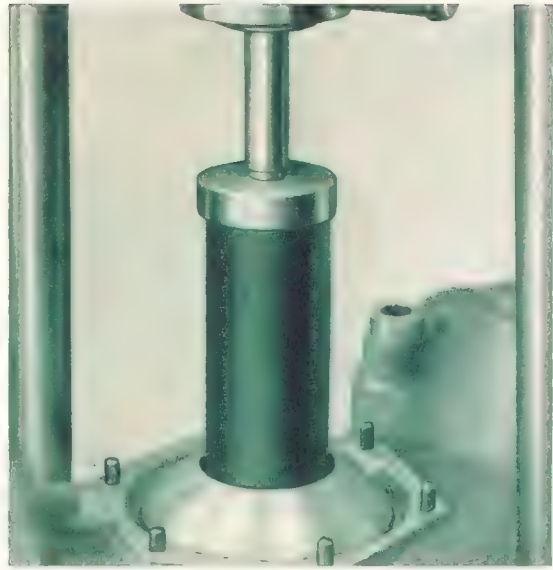
- 12 - Withdraw selector shafts. Prevent the detent balls jumping off by covering the holes. Remove selector forks.



- 13 - Remove detent balls and springs.

- 14 - Take off the two selector shaft interlock pins.

- 15 - Remove the differential ball bearings, using extractor VW 290b or Repair Press VW 400 in conjunction with VW 409, VW 415, and VW 433.

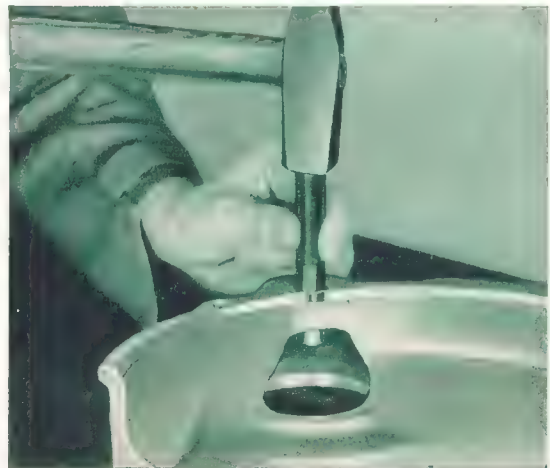


- 16 - Remove clutch operating shaft and lever, return spring and return spring seat.

### Assembly

This is effected by reversing the preceding operations, but the following points should be noted:

- 1 - Thoroughly clean transmission case and check for wear, external damage and cracks. In the case of the drive pinion or ring gear (crown wheel) being damaged (e. g. breakage), check the bores in the transmission case webs for alignment; replace transmission case if necessary.
- 2 - Check starter shaft bush for wear, using plug gauge VW 246. If necessary, replace the bush by means of drift VW 222 or Repair Press VW 400 in conjunction with VW 401, VW 408 and VW 438.



**Note:**

Replacement of starter shaft bush with engine in situ:

Removal with extractor ..... VW 228 a  
Installation with drift ..... VW 222



Check square seating of ball bearings by means of gauge VW 285, the permissible tilt being 0.02—0.04 mm (0.0008"—0.0016").



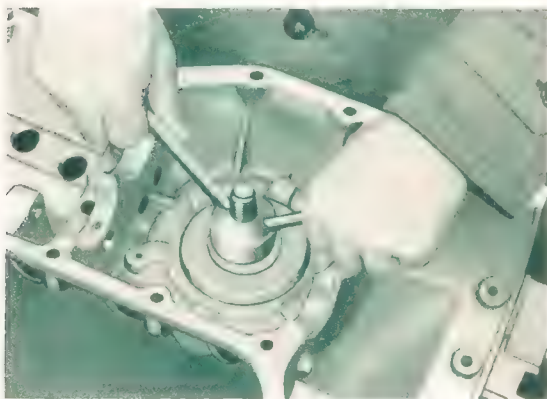
3 - Check clutch operating shaft bushes for wear, replace as necessary.

5 - Examine reverse sliding gear bush and reverse sliding gear shaft; if necessary, replace.

**Important!**

The clutch operating shaft must in all cases be installed before the transmission case halves are screwed together.

4 - Press the differential ball bearings in place, using Special Tool VW 290a or Repair Press VW 400 in conjunction with VW 401, VW 409, VW 415 and VW 433.

**Note:**

The lubrication of the reverse sliding gear has been changed from Chassis No. 1216555 in the following manner:

- 1 - Both oil holes are no longer between the teeth of the reverse sliding gear, but at the base of the annular groove for the selector fork.
- 2 - The bronze bushing has been discarded.
- 3 - The new bushing made of "Main" metal is supplied with an inner annular groove and is completely smooth at the diameter of the press fit — with the exception of two fair sized oil holes which must register with the oil passages in the gear.

**Caution!**

If the new type reverse sliding gear is to be installed in earlier cars, be sure to take notice of the following: Because of the oil holes in the annular groove of the reverse sliding gear, the upper end of the selector fork must be round. Any edges should be rounded off.

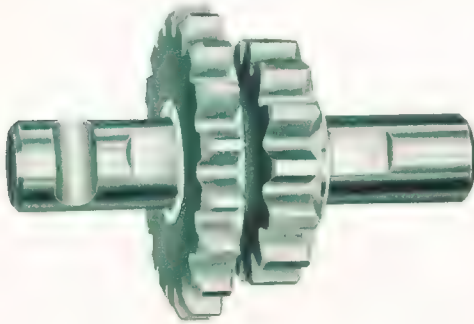
**Note:**

The lubrication of the reverse sliding gear has been altered from Chassis No. 1473411.

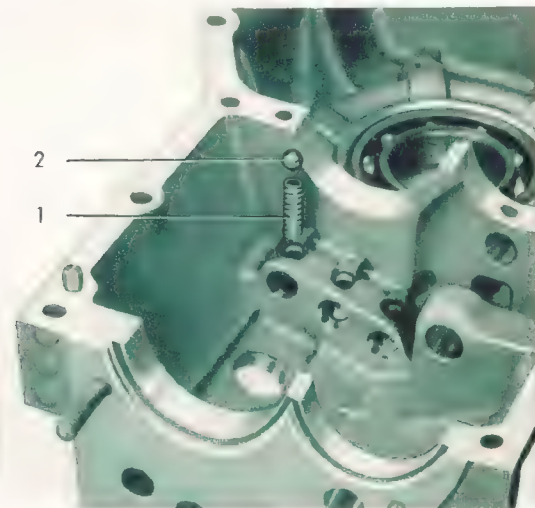
- 1 - The two oil passages in the annular groove of the reverse sliding gear for the selector fork have been omitted.
- 2 - The shaft for the reverse sliding gear has been provided with a flat side on the sliding surface. (Part No. 113309515 A).
- 3 - The two oil passages and the annular lubrication groove in the "Main" metal bush have been omitted.

The modified reverse sliding gear must be installed in conjunction with the modified reverse sliding gear shaft provided with a flat side.

The Part No. 113309501 A for the reverse sliding gear with bush remains the same.



- 6 - Examine detent springs and replace as necessary. Free length of detent spring: 25 mm (1''); wear limit: 23 mm (0.9''). The force applied to overcome the detent ball undercuts on the selector shafts should amount to approx. 15—20 kg (35—45 lbs.). A test should be carried out with the drive pinion removed, if difficult gear shifting is experienced.



1 - Detent spring

2 - Detent ball

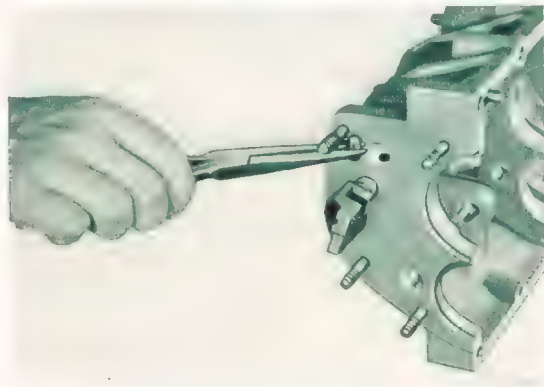
- 7 - Install and secure selector shafts and forks in the following order:

- a - Install and secure selector shaft and fork for reverse gear.
- b - Secure reverse sliding gear shaft.

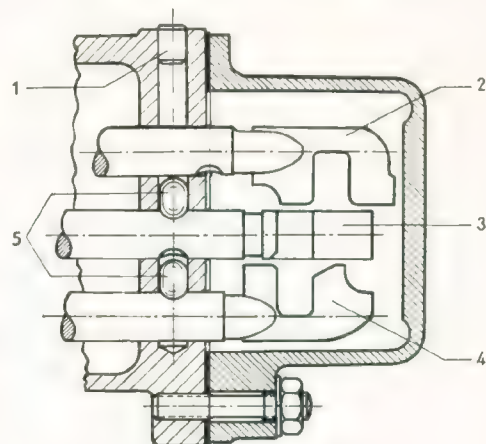
**Important!**

When turning the open transmission case, care should be taken to insure that the lock pin for the reverse sliding gear shaft does not fall out.

- c - Install selector shafts and forks for 1st and 2nd and for 3rd and 4th gears, taking care not to omit the two interlock plungers. Screw the selector fork locking screws in place, but do not yet tighten them.



Check for proper interlocking by engaging a gear. The selector shaft next to the one used must be locked. When engaging 1st or 2nd gears (center selector shaft), the two other selector shafts should be locked.



- 1 - Plug for interlock plunger channel
- 2 - Selector shaft for reverse
- 3 - Selector shaft for 1st and 2nd gears
- 4 - Selector shaft for 3rd and 4th gears
- 5 - Interlock plungers



- 8 - Check selector forks for wear. The clearance between selector fork and operating sleeve or 1st gear should not be in excess of the specified limits. Replace worn parts should the necessity arise.
- 9 - Inspect differential and replace worn or damaged components.

**Note:**

The differential housing, cover, and ring gear retaining screws were modified with effect from Chassis No. 1—557124 for a better lubrication of the fulcrum plates. Introduced at the same time was the oil deflector plate that guides the oil to the differential housing apertures.

The deflector plate is attached to the clutch side of the transmission case by means of a hex. bolt M 8 x 20, the corresponding nut being welded to the plate. The bolt is secured in position by means of a copper lock plate.

This modification can be incorporated in earlier synchromesh transmissions as detailed in the "Technical Bulletin H 2".

**Important!**

The modified parts (differential housing, cover, and ring gear retaining screw)s are **not** interchangeable with those used on cars up to Chassis No. 1—557124.

When placing the differential in position, be sure the shims occupy their original positions.

**Attention!**

VW Passenger Ring gear (crown wheel)  
Cars: in left transmission case half.

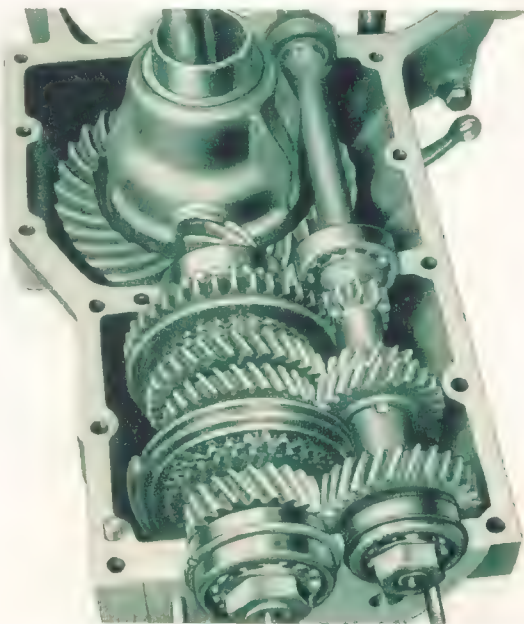
VW Transporter: Ring gear (crown wheel)  
in right transmission case half.

- 10 - Inspect drive pinion, main drive shaft, and oil seal; replace worn or damaged parts.

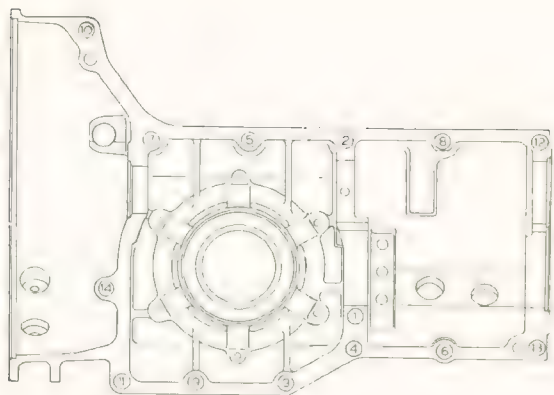
Oil the contact surface of the oil seal lip before sliding the oil seal on the main drive shaft. Care must be taken to see that the ball bearing retaining rings are bedding correctly in the provided ring grooves. Their gaps should be slightly above the jointing face of the left transmission case half. Lightly tap drive pinion and main drive shaft towards ring gear (crown wheel).

- 11 - Carefully adjust 1st-and-2nd selector fork and 3rd-and-4th selector fork as follows:

- a - The 1st-and-2nd selector fork should be carefully positioned to insure that the 2nd and the 1st gears correctly engage when carrying out a shifting control. If found that the 2nd gear only engages partly, the selector fork should be positioned closer towards the 2nd gear.
- b - The 3rd-and-4th selector fork should be positioned to insure that both gears engage the same amount. Departures from that position should be corrected after a shifting control to assure a proper functioning of the synchro unit.
- c - After the selector forks have been positioned, the locking screws should be tightened to a torque of 2.5 mkg (18 ft. lbs.), using torque wrench VW 118 in conjunction with 11 mm hex. socket.



- 12 - Plug up the two adjusting holes in the transmission case.
- 13 - Before attaching the transmission case halves, check gearshifting and proper meshing of all gears.
- 14 - Clean all jointing faces and oil seal seatings and lightly coat them with Sealing Compound D 1 a.
- 15 - Tighten transmission case screws in the below indicated order to a torque of 2 mkg (14.5 ft. lbs.).



16 - Connect clutch operating lever return spring.

**Note:**

Two magnetic oil drain plugs are recommended for use in cases where new car owners are known to be lacking experience and practice in operating a car, so that improper gear shifting can be expected (e. g., shifting down to first without double declutching, or engaging reverse before the car has come to a dead stop). Such practice involves the risk of metal chips breaking off the gear teeth edges and getting lodged between balls and races of the bearings, which are then bound to develop a noise sooner or later.



To make the magnetic plugs fully serve their purpose, they should, if possible, be installed before the customer takes delivery of the car. Experience has shown that metal chips will occur especially during the first few hundred miles of operation on account of abrasion and clash when shifting in an unskilled manner.

**Maintenance**

Cleaning the plugs at prescribed intervals is essential, as the permanent magnets can hold only a limited amount of foreign matter.

**Intervals**

After 500 km (300 miles), 2,500 km (1,550 miles), 5,000 km (3,000 miles), and then every 5,000 km (3,000 miles).

**Note:**

From August 1957 the oil drain plugs have been moved from the center to the ends of the transmission case where oil impurities can collect which are flushed out when draining the oil.

## Synchromesh Transmission — Replacing 3rd and 4th Gear Wheels

(December 1957)

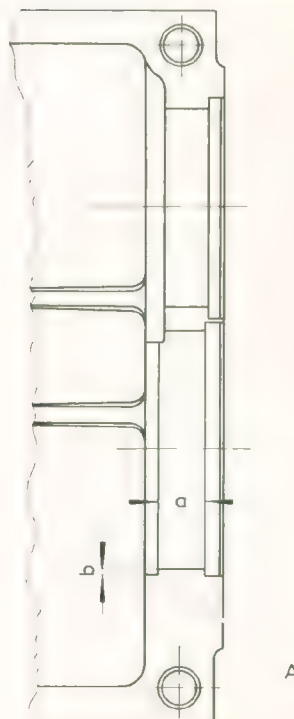
**General**

The modified gear wheels for 3rd and 4th speed (spare part nos. 113309275 A and 113309341 A) have tooth ratios of 23 : 28 and 28 : 23.

If these wheel pairs are subsequently fitted in a transmission of older design, special attention has to be paid to the 4th speed gear running freely at the partition between transmission case and gear-shift housing when the pinion assembly has been put in place and the case is still open. If necessary, the case has to be reworked at the spot indicated (A).

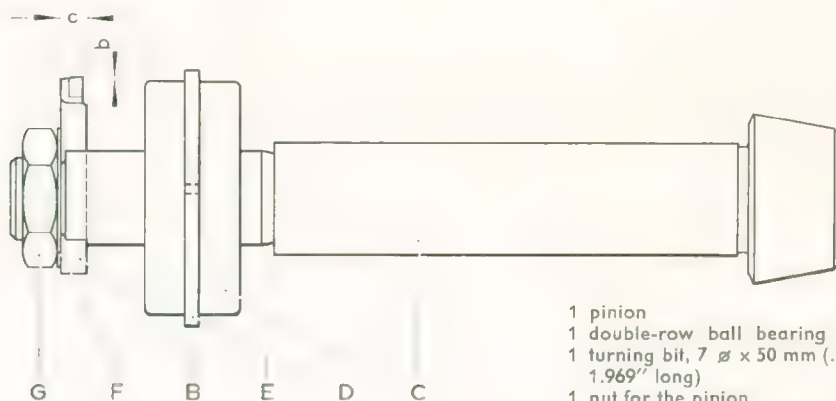
The following dimensions have to be complied with:

a = 12 mm (.472")  
b = 1.5 mm (.059")



### Requisite tools

The transmission case can be reworked by using a turning tool which can be manufactured from a few worn parts at any workshop. For this purpose you will need:



- 1 pinion
- 1 double-row ball bearing with lock ring
- 1 turning bit, 7  $\varnothing$  x 50 mm (.276" dia, 1.969" long)
- 1 nut for the pinion
- 1 shim

Reduce the pinion diameter at the seat for the double-row ball bearing until the bearing can be easily slid on by hand.

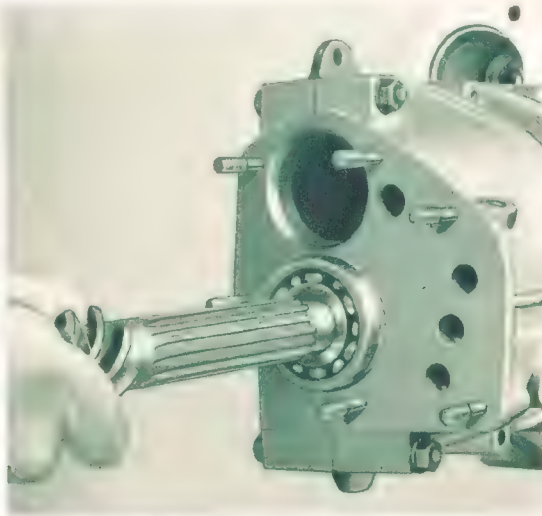
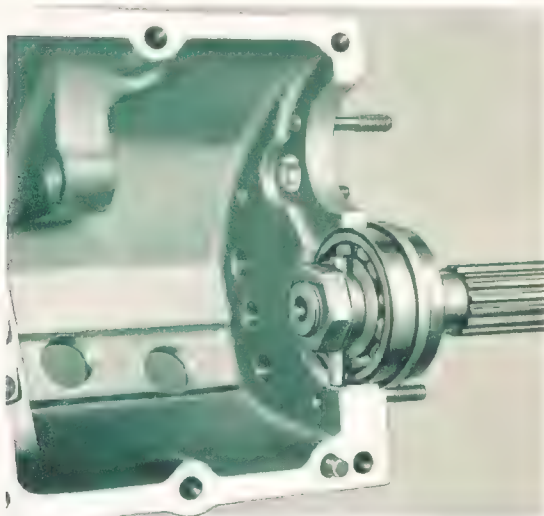
Now, use a cylindrical bit of 0—7 mm (0—.276") diameter to drill into the pinion a hole for the accommodation of the turning bit, as shown on the drawing. Fit the turning bit into this bore and lock it into position by means of a shim and the pinion nut so that the cutting edge extends 1.5 mm (.059") beyond the outer race of the double-row ball bearing.

### Reworking the transmission case

Place the turning tool into the open transmission case so that the pinion and the bevel gear which serve as a handle protrude from the case. Then fit the other half of the case and secure it by means of two hex. head screws.

Rework the two case halves by turning the pinion by hand.

As soon as the turning tool is available, the job can be completed within about ten minutes.





# Replacing Main Drive Shaft Oil Seal

(With rear axle in situation)

The oil seal permits a replacement without a removal and disassembly of the transmission. The transmission case is provided with a plane contact surface for the oil seal.

- 2 - Slide oil seal on main drive shaft and drive it in position by means of the tool VW 291 b.

## Removal

- 1 - Remove engine.
- 2 - Remove clutch release bearing.
- 3 - Remove oil seal from transmission case, taking care to avoid any damage.

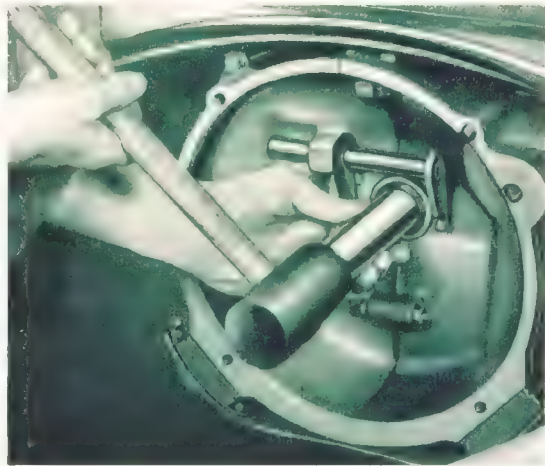
## Installation

This is a reversal of the above operations, but the following points should be noted:

- 1 - Lightly coat the exterior of the oil seal with sealing compound. Oil main drive shaft and oil seal lip.

### Attention!

Carefully slide the oil seal on the shaft to avoid the spring around the lip coming out of place.





## Oversize Transmission Case Studs

The tapped stud holes in the transmission case may become damaged due to overstraining, or some other reason, leading in some cases to oil leaks.

It is then permissible to re-tap the holes 2 mm oversize. To ensure a correct sealing, the thread should be cut, however, to the following unorthodox dimensions:

Female Thread in Transmission Case			
Nominal Size	Major Diameter (mm)	Pitch Diameter (mm)	Minor Diameter (mm)
M 8	7.630—7.705	7.188—7.300	6.416—6.731
M 10	9.616—9.698	9.026—9.138	8.097—8.452

The following drills must be used for boring the holes:

6.7 mm drill for thread M 8

8.4 mm drill for thread M 10

The threads are cut by single thread machine taps (DIN 376), the outer diameters of which should be ground down to the following dimensions (VW Works Norm ZN 7038):

Taps			
Nominal Size	Major Diameter		
	Low Limit (mm)	High Limit (mm)	Permissible Wear up to (mm)
M 8	7.660	7.680	7.630
M 10	9.640	9.660	9.616

The corresponding studs, which are oversize at the end to be screwed into the transmission case, can be obtained as spare parts.

## Reconditioning Main Drive Shaft

### Disassembly

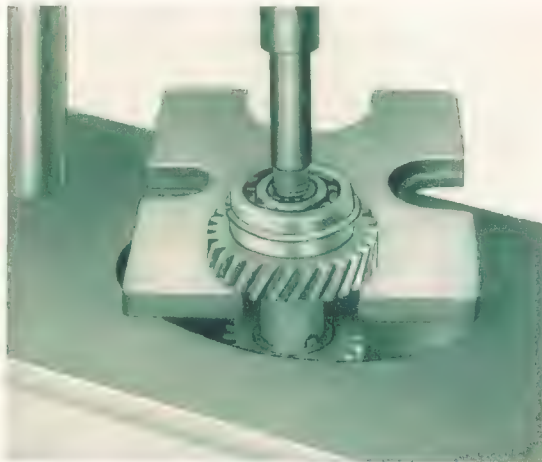
- 1 - Disassemble transmission case and lift out main shaft.
- 2 - Remove ball bearing retaining ring at first speed gear, using tool VW 161 a.



- 3 - Pry up lock plate and remove the nut by means of a 27 mm wrench.



- 4 - Remove fourth speed gear and ball bearing by means of the Repair Press VW 400 in conjunction with VW 401 and VW 408.



- 5 - Remove spacer between 3rd and 4th gear by means of a screwdriver.



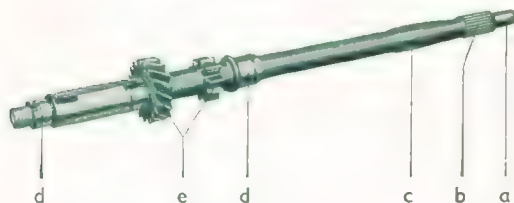
- 6 - Remove third speed gear by means of the Repair Press VW 400 in conjunction with VW 401, 409, 421, and 431.
- 7 - Take off the keys in the main drive shaft.
- 8 - Remove ball bearing at 1st speed gear by means of Repair Press VW 400 in conjunction with VW 401 and 412.
- 9 - Clean the main drive shaft, especially its center holes.

### Inspection

- 1 - Check main drive shaft for wear:
  - a - Check main drive shaft pilot for wear.



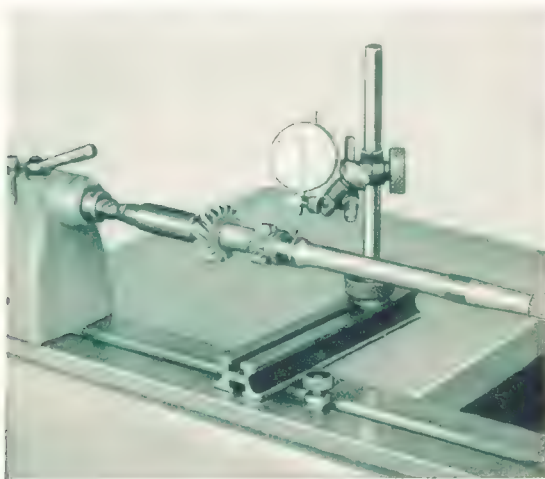
- b - Check splines for wear (radial clearance).
- c - Check oil seal seating for scores and signs of wear.
- d - Make sure that the ball bearings and gears (3rd and 4th speeds) are a press fit on their seats.
- e - Check first and second speed gears for wear and damage.



- a - Pilot
- b - Splines
- c - Oil seal seat
- d - Seat (3rd and 4th gears)
- e - Gears for 1st and 2nd speeds

Excessive wear, damage or excessive play necessitate a replacement of the main drive shaft. If the gears for the 1st and 2nd speeds are found to be excessively worn, the corresponding gears on the drive pinion shaft should also be replaced.

- 2 - Check main drive shaft for run-out. Place main drive shaft between two points and check at



intermediate seat. Permissible run-out: max. 0.05 mm (0.002"). If the run-out is in excess of this limit, the main shaft may be straightened in cold condition by means of Repair Press VW 400 in conjunction with VW 405 and VW 406.

#### Note:

With the main drive shaft installed in the transmission case, the run-out (max. 0.2 mm/0.008") should be measured at the pilot.

- 3 - Inspect ball bearings for wear and damage, replace as necessary.
- 4 - Check third and fourth speed gears for wear and damage, replace as necessary.

#### Attention!

The gears for the third and fourth speeds must only be replaced in pairs.

#### Assembly

This is effected by reversing the disassembly procedure, but the following points should be observed:

- 1 - Press ball bearing at 1st gear in position, using Repair Press VW 400 in conjunction with VW 401 and 419.
- 2 - Press retaining ring for ball bearing at 1st gear in position, using Repair Press VW 400 in conjunction with VW 401 and 411 (use that side of the plate VW 401, on which the center hole is not countersunk). A good lubrication of main drive shaft and retaining ring should precede the above operation.



3 - Place the two keys in position.

### Important!

Before pressing the gears and ball bearings in place, they must be heated to approx. 80 °C (180 °F) in an oil bath. Gears and ball bearings must be a press fit on the main shaft.

4 - Press 3rd gear in place, using Repair Press VW 400 in conjunction with VW 401, 412, 416, and 419.

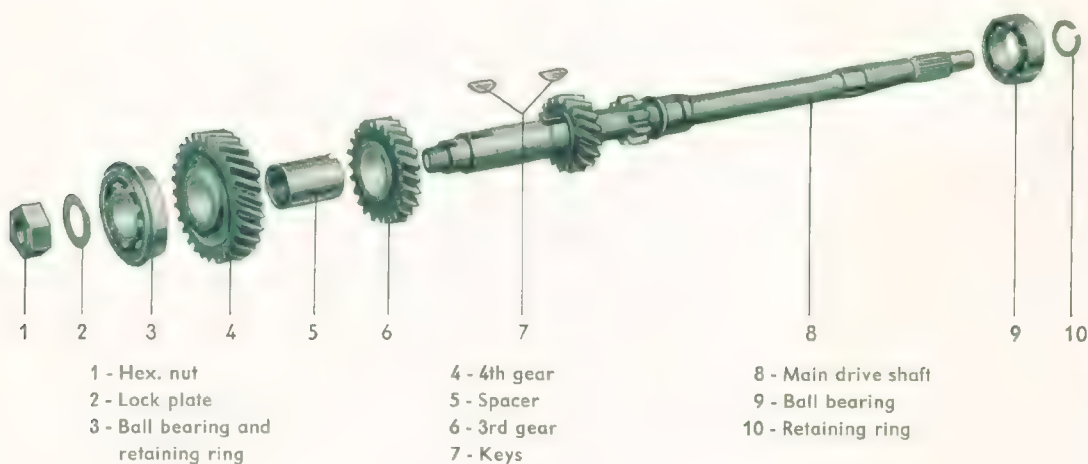
Care should be taken that the tube VW 416 clears the key when pressing.

The 3rd gear must tightly bear against the 2nd gear.

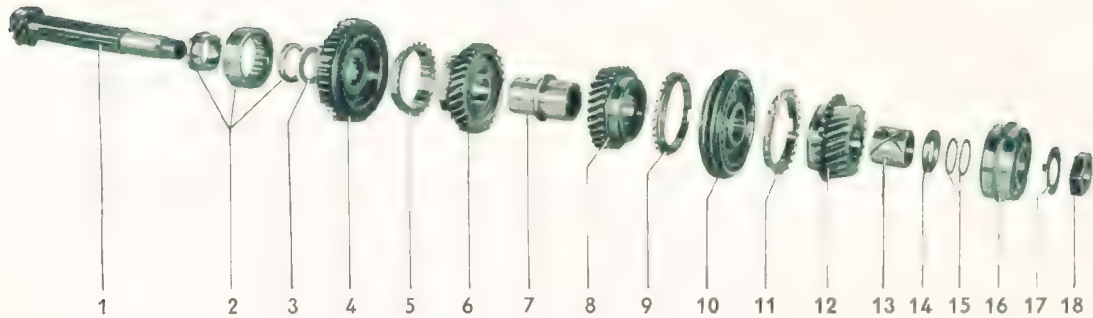
5 - Expand spacer by inserting a screwdriver in the slot and slide it on the shaft.

6 - Press 4th gear and then the ball bearing individually in place, using Repair Press VW 400 in conjunction with VW 401, VW 412 and VW 420. When replacing the ball bearing do not forget to fit the retaining ring.

7 - Fit the lock plate so that the nose comes to rest in the slot which is cut in the main drive shaft. Tighten the nut by means of a hex. socket 27 mm and the torque wrench VW 118 to a torque of 3 mkg (22 ft. lbs.). Secure the nut with the lock plate.



## Reconditioning drive pinion



- 1 - Drive pinion
- 2 - Roller bearing
- 3 - Shim
- 4 - Clutch gear and 1st gear
- 5 - Synchronizer stop ring (2nd gear)
- 6 - 2nd gear

- 7 - Bush
- 8 - 3rd gear
- 9 - Synchronizer stop ring (3rd gear)
- 10 - Clutch gear and sleeve for 3rd and 4th gears
- 11 - Synchronizer stop ring (4th gear)
- 12 - 4th gear

- 13 - Bush
- 14 - Friction washer
- 15 - Shims
- 16 - Double row ball bearing and retaining ring
- 17 - Lock plate
- 18 - Nut

### Disassembly

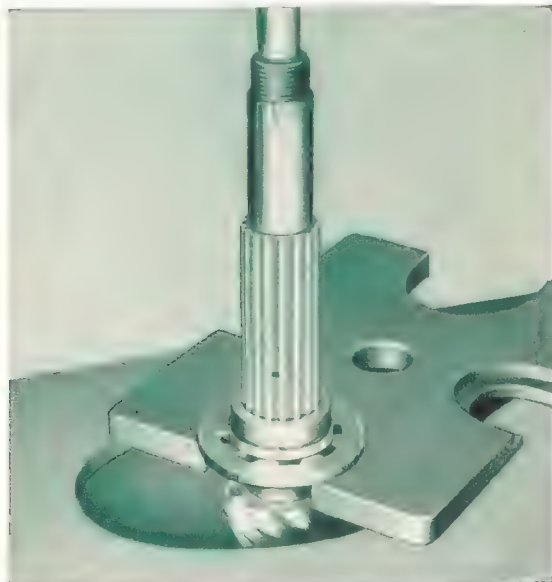
- 1 - Open the transmission case and lift out drive pinion.
- 2 - Place drive pinion in holding fixture VW 314.
- 3 - Pry off nose of lock plate and screw off the nut.
- 4 - Remove double row bearing on Repair Press VW 400 in conjunction with VW 402 and VW 408.
- 5 - Take off shims and friction washer for 4th gear.
- 6 - Remove 4th gear, bush, and synchronizer stop ring.





As to the Klingelnberg gear sets, the thrust ring VW 449a is still used on drive pinions with a modulus of 3 or 3.25, and the thrust ring 449b on pinions having 8 teeth (tooth ratio 8 : 35).

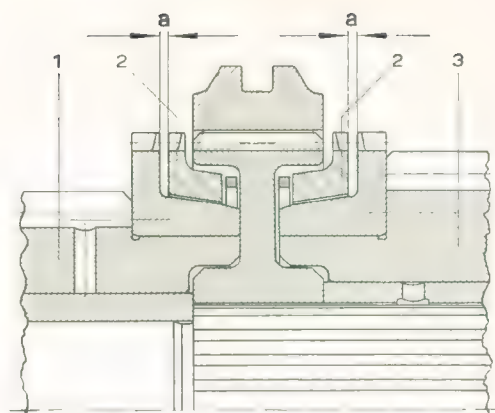
Use Repair press VW 400 in conjunction with VW 402, 441 and 449c for the removal of the needle bearing inner ring from the drive pinion shaft.



- 14 - Clean drive pinion. The oil passages must be free and unobstructed. Compressed air should be used to blow them out.

#### Inspection

- 1 - Inspect drive pinion for wear and damage, if necessary replace drive pinion and ring gear as a pair. (Note matching number on pinion and ring gear).
- 2 - Check condition of roller bearing and double row ball bearing; replace if necessary.
- 3 - Check gears for wear and damage; replace as necessary (3rd and 4th speed gears only in pairs).
- 4 - Check all synchronizer components for wear.
  - a - Clean the internal cone surface of the stop rings with a wire brush.
  - b - Check the clearance between the stop ring face and the clutch teeth on the corresponding gear. If the wear limit is found to have reached ( $a = 0.3 \text{ mm}/0.012''$ ), the stop ring should be replaced. Premature wear of the stop rings is attributable to the clutch being in a bad condition or the driver incorrectly operating the clutch.



$$a = 0.3 \text{ mm } (0.012'')$$

- 1 - 4th gear  
2 - Synchronizer stop ring  
3 - 3rd gear

c - If a gear will not engage, although the clutch is fully released, it may be due to the teeth of the stop ring too much out of line with the splines of the operating sleeve. This condition is caused by the slots in the stop ring being worn.

d - All worn parts should be replaced.

- 5 - Check 3rd and 4th gear bushes, spacer, and shims for wear and replace as necessary.

#### Assembly

This is a reversal of the above operations, but the following points should be observed:

- 1 - The roller bearing inner race should be heated in an oil bath to  $90^\circ\text{C}$  ( $194^\circ\text{F}$ ) before pressing it in position by means of the Repair Press VW 400 in conjunction with VW 401, 411, and 430.

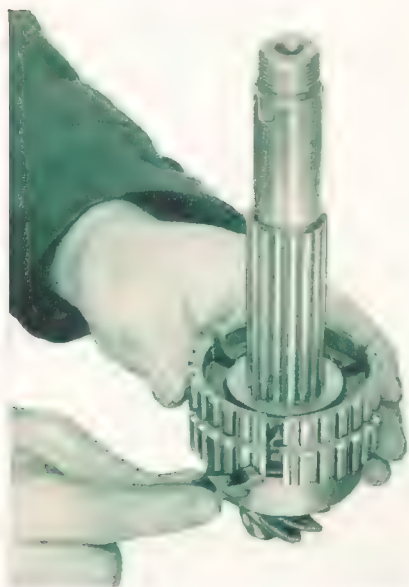
#### Important!

Be sure the roller bearing is a press fit on the drive pinion. A loose fit necessitates a replacement of the worn parts.

- 2 - Install shim for reducing the total end play of the parts assembled on the splined portion of the drive pinion. Determine the thickness of the shim to be installed after having installed the clutch gear for the 3rd and 4th speeds.

Shims of 0.1 and 0.2 mm (.004" and .008") are available for selective fitting.

- 3 - Install snap ring in the recess cut in the 2nd speed clutch gear.
- 4 - Slide 2nd speed clutch gear on drive pinion shaft and fit the three coil springs in the provided holes. Put the three shifting plates in position, taking care that their noses are held down by the snap ring.



Press the spring-loaded shifting plates into their slots and slide 1st gear on the clutch gear until the shifting plates engage in the circumferential recess inside the 1st gear.



Be careful that the three chamfered splines of the 1st gear face the shifting plates, as otherwise shifting troubles will arise, necessitating a disassembly of the transmission. Should the shifting plates become dislodged, permitting the 1st gear to slide down after the drive pinion has been assembled, the 1st gear can be repositioned from the pinion side.

#### Note:

From Chassis No. 1—602400 onwards, the clutch gear for the 2nd speed is provided with an annular groove. The splines of the clutch gear portion that drives the engaged first gear are offset by 0.05 mm—0.08 mm (.002"—0.003") on the coast side, so that the first gear abuts against the projecting edges of the splines for the 2nd gear when coasting.

Should the first gear on earlier transmissions tend to slip out repeatedly, the installation of the new type clutch gear will be the only remedy.

The splines of the 2nd speed clutch gear which drive the engaged 1st gear are now displaced by 0.02—0.06 mm (.0008"—.0024") on the coasting sides (previously 0.04—0.08 mm/0.0016"—.0031"). This displacement provides a stop for the 1st gear at the annular groove, thus counteracting the tendency of the 1st gear to slip out when coasting.

Following are the causes that may result in a slipping out of the 1st gear when coasting:

#### 1 - Irregularities at 2nd speed clutch gear

The displacement of the spline coasting sides does not on all splines reach the minimum of 0.02 mm (.0008").

##### Remedy:

Install a clutch gear on which the displacement of all splines is at the upper limit (0.06 mm/.0024").

##### Caution:

No attempt should be made to remachine the clutch gear in order to obtain a displacement in excess of the upper limit, as such practice will make the 1st gear liable to stick.

#### 2 - Selector fork maladjusted

The 1st gear not sufficiently in mesh.

##### Remedy:

Position the selector fork further towards the 1st gear. With the 2nd gear engaged, the internal splines of the 1st gear should just cover the clutch teeth of the 2nd gear.

If the edges of the splines at the annular groove are found to be worn due to the first gear having slipped out, a new clutch gear should be installed on which the displacement is at the upper limit (0.06 mm/.0024").

### 3 - Tooth flanks of the 1st speed gears being tapered

The teeth of these gears may have become tapered due to:

- a - frequent slipping out,
- b - damage caused by constant crashing of gear when shifting down.

In some isolated cases, also defects in material or workmanship may be responsible for such deformation of the teeth.

#### Remedy:

Replace clutch gear, 1st gear, and main drive shaft.

#### Important:

After having assembled the drive pinion, check if the 1st gear can be shifted into proper mesh. Correct the position of the selector fork, if found necessary.

To guard against slipping out of 1st gear when coasting the 2nd speed clutch gear (Part No. 113309233 A) has been modified as follows from Chassis No. 1584655:

- 1 - The splines of the 2nd speed clutch gear which drive the engaged 1st gear are now displaced on the coasting sides up to the annular groove by 0.03—0.07 mm (.0012"—.0027") previously 0.02—0.06 mm (.0008"—.0024").
- 2 - The annular groove has been displaced by 0.8 mm (.031") toward the 1st gear. This results in an increased meshing depth with the 1st gear engaged. The dimension from the hardened holding edge to the outer edge of the clutch gear on the side for 1st gear is  
**New:** 21.0—0.3 mm (.827 —.012")  
 (previously: 21.8—0.3 mm/.858"—.012")
- 3 - On installation of this clutch gear in transmissions without needle bearings, shorter shifting plates (Part No. 113309239 A) must be installed. The 2nd speed clutch gear (Part No. 113309233) for transmissions without needle bearings will not be available after stocks are used up.

#### Note:

Main drive shaft and 1st speed gear wheel should only be replaced after repeated slipping out of 1st gear or if, because of improper gear changing, the teeth have become damaged.

The new 2nd speed clutch gear (Part No. 113309233 A) is available as a Spare Part.

- 5 - Place 2nd speed stop ring on the clutch gear so that the shifting plates engage with the three slots.
- 6 - Place 2nd and 3rd gears on the bearing bush. Carefully slide the bush on the drive pinion shaft to avoid an upsetting, which would lead to an unpermissible reduction of the radial clearance of the gears.

#### Note:

Commencing with Chassis No. 1—0575415, the 3rd gear train has an altered number of teeth for better meshing and smoother operation:

Number of Teeth	Earlier Type Part No. 305 387	Ratio	New Type Part No. 305 387 a	Ratio
3rd Gear on Main Pinion	28	1.22 : 1	27	1.23 : 1
3rd Gear on Drive Drive Shaft	23		22	

These gears can be installed on earlier cars.

All drive pinions on VW Passenger Cars from Chassis No. 1388439 will be assembled as follows:

The thrust faces of the bush for the 3rd and 4th gears have been enlarged by omitting the 15° inside chamfers.

- 7 - Place 3rd speed stop ring on the cone surface of the gear. (The synchronizer stop rings for the 3rd and 4th gears are interchangeable).

- 8 - Assemble synchro unit for 3rd and 4th gears as follows: Slide the operating sleeve on the clutch gear, put the three shifting plates in position, and install the two snap rings. The two ends of the ring must be in one sector between two shifting plates.



#### Note:

- a - From Chassis No. 1—525624 the 3rd and 4th gears on the drive pinion shaft are provided with one thrust ring each. The ring is located at the plain side of the clutch teeth and is to prevent the operating sleeve from moving sidewise when the gear is engaged. It is not possible to provide earlier gears with thrust rings.

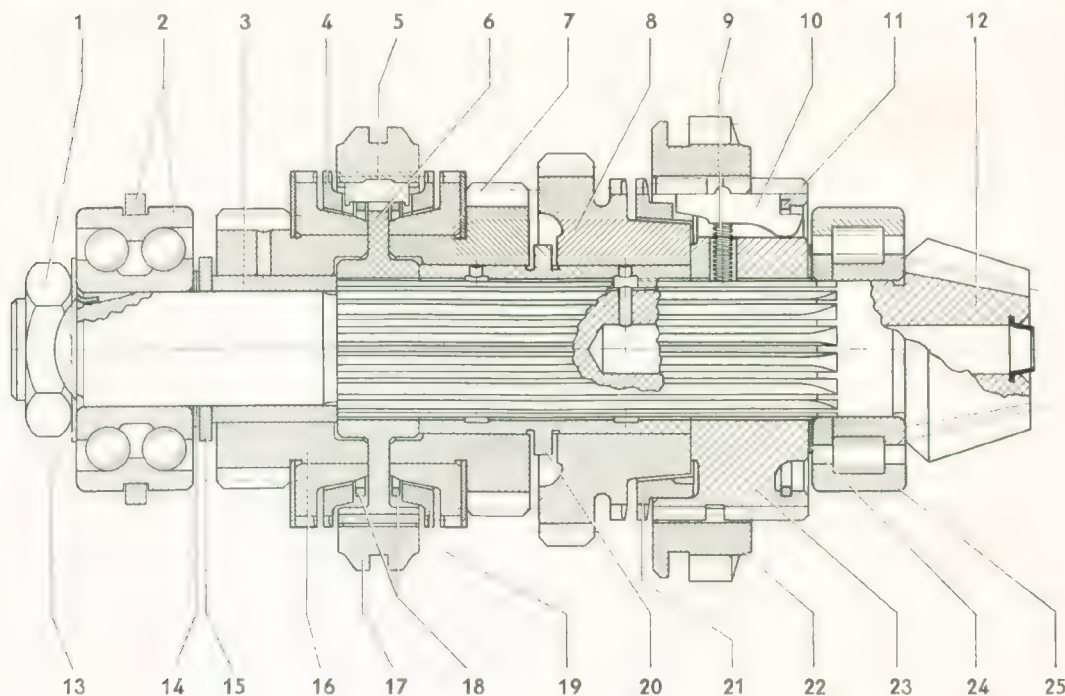


- b - If the selector fork for the 3rd and 4th gears is worn from contact with the operating sleeve, or if one of the two gears tends to slip out, install the new type parts mentioned below:

Set the selector fork for the 3rd and 4th gears so that the operating sleeve lightly touches the thrust ring of the 4th gear, after having engaged that gear. At the same time care should be taken to insure that the fork is free from lateral thrust in the groove of the operating sleeve.

- c - At the same time the width of the operating sleeve for 3rd and 4th gears has been increased to 19.1—19.0 mm (.752"—.748"). On earlier transmissions the width of the operating sleeve amounts to 18.0—17.9 mm (.709"—.705") or 18.7—18.6 mm (.736"—.732"). Earlier type operating sleeves **must not** be matched with gears being provided with thrust rings.

- d - From Chassis No. 1—501417, the 3rd-and-4th gear selector fork contact faces form a complete radius.



**Drive Pinion (Sectional View)**

- |   |                           |                             |                             |
|---|---------------------------|-----------------------------|-----------------------------|
| 1 - Nut   | 6 - Clutch gear           | 13 - Lock plate             | 20 - Bush                   |
| 2 - Double row ball bearing with retaining ring | 7 - 3rd gear              | 14 - Shims                  | 21 - Synchronizer stop ring |
| 3 - Bush  | 8 - 2nd gear              | 15 - Friction washer        | 22 - 1st gear               |
| 4 - Synchronizer stop ring                      | 9 - Shifting plate spring | 16 - 4th gear               | 23 - Clutch gear            |
| 5 - Shifting plate                              | 10 - Shifting plate       | 17 - Clutch gear sleeve     | 24 - Shim                   |
|   | 11 - Snap ring            | 18 - Snap rings             | 25 - Roller bearing         |
|   | 12 - Drive pinion         | 19 - Synchronizer stop ring |                             |

- 9 - Slide the assembled synchro unit on the drive pinion shaft and turn the third speed stop ring until the shifting plates engage with the slots.

- 10 - The clutch gear face must be nearly flush with the splines on the drive pinion.

#### Upper Tolerance Limit

The clutch gear face is 0.05 mm (.002") above the splines.

#### Lower Tolerance Limit

The splines on the drive pinion are flush with the clutch gear face.

If the upper or lower tolerance limit is exceeded, the end play of the parts assembled on the splined portion of the drive pinion should be corrected by fitting a shim between roller bearing and 2nd speed clutch gear or by altering the thickness of the shim. But first it should be made sure that the parts on the splined portion of the drive pinion are correctly assembled.

#### Note:

From Chassis No. 1388439 all parts on the pinion up to the clutch gear for 3rd and 4th gears are assembled so that the clutch gear face is either flush with or 0.05 mm (.002") above the spline ends of the pinion.

### Important!

Whenever repairs on earlier cars call for a disassembly of the drive pinion, the new tolerance as specified above should be adhered to. The parts described should be pressed into position.

- 11 - Place the 4th speed stop rings on the clutch gear so that the shifting plates engage with the slots.
- 12 - Install 4th gear bush, 4th gear, and friction washer.

### Note:

Commencing with Chassis No. 1—0575415, the 4th gear train has an altered number of teeth for better meshing and smoother operation:

Number of Teeth	Earlier Type Part No. 305 417	Ratio	New Type Part No. 305 417 a	Ratio
4th Gear on Drive Pinion	22	0.79:1	22	0.82:1
4th Gear on Main Drive Shaft	28		27	

These gears can be installed on earlier cars.

### Note:

From Chassis No. 1430323 the 4th speed gear on the drive pinion (4th gear train, Part No. 113309341) is no longer provided with the 2.4 mm dia. oil passage.

This is to insure adequate lubrication between gear wheel and bush even at sustained high speed.

Gear wheels of previous design may be used up.

- 13 - Install shims on drive pinion as required to obtain the correct axial adjustment. Shims of the thicknesses 0.15, 0.2 mm and 0.3 mm (0.008" and 0.012") are available for this purpose so that the axial adjustment can be corrected in units of 0.1 of a millimeter.

a - When replacing parts of the drive pinion assembly which do not affect the axial adjustment, the total thickness of the shims should not be altered to insure a correct meshing of pinion and ring gear.

b - When replacing drive pinion or other parts which affect the axial adjustment, the proper amount of shims must be determined once more.

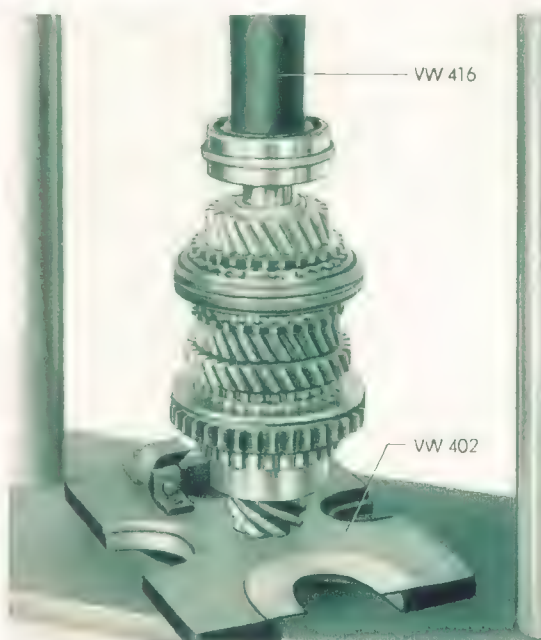
The standard thickness of the total shims is 0.7 mm (0.0275"). The plus or minus marking on the drive pinion face must be considered in this connection.

### Example:

Standard thickness of shims .... 0.7 mm  
 Axial tolerance discrepancy — 0.18 mm. This value is to be raised to the next tenth of a millimeter, namely ..... — 0.2 mm  
 Total thickness of shims required 0.5 mm

The total thickness of shims should be checked by the test mandrel VW 289 b and an impression of the drive pinion tooth contact when positioning drive pinion and ring gear.

- 14 - Press double row ball bearing in position, using Repair Press VW 400 in conjunction with VW 402 and VW 416. The filling slot in the outer race of the bearing must face the drive pinion nut.



- 15 - Install new lock plate after it has been coated with graphited oil.

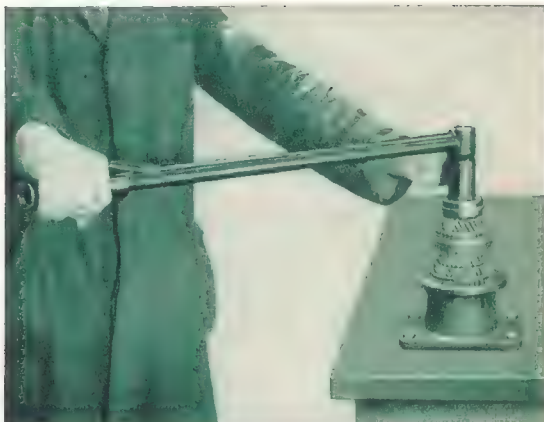
### Note:

The thrust face of the drive pinion nut should be dipped into graphited oil to prevent the nut from seizing on the lock plate, as this would lead to the tab breaking off.

### Important!

It is absolutely necessary to use a new lock plate whenever the drive pinion nut has been removed.

- 16 - Tighten drive pinion nut with a torque wrench to a torque of 11—12 mkg (80—87 ft. lbs.).

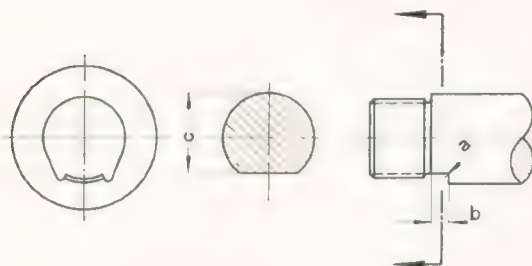


### Important!

Be sure not to exceed a torque of 12 mkg (87 ft. lbs.), as this would even cause the tab of a graphite-coated lock plate to break off.

### Note:

In place of the groove for the tap of the lockplate from Chassis No. 1454551 the drive pinion is now provided with a flat surface. The shape and dimensions of the new lockplate have been altered accordingly.

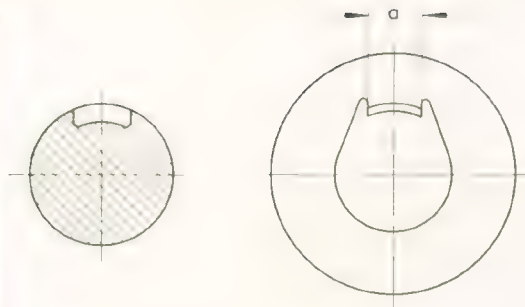


$$\begin{aligned} a &= 0.5 r + 0.5 \\ b &= 5 + 0.2 \text{ mm} \\ c &= 22.3 - 0.2 \text{ mm} \end{aligned}$$

The new lockplate can be used on previous drive pinions if the sides of the groove are filed off as specified on the drawing.

In older transmissions the nut must only be tightened to the new torque if the drive pinion has been provided with a flat surface and if the new lockplate has been installed. Otherwise tighten to a torque of 80–87 ft. lbs.

From Chassis No. 1595675 the groove for the lockplate tab on the main drive shaft (Part No. 113309101) is now 3 mm (.117") wider and provided at the base with a convex surface. Shape and dimensions of the new lockplate (Part No. 113309151 A) have been altered appropriately. The torque for the nut remains unchanged at: 4.0–5.0 mkg/29–36 ft. lbs.



$$a = 7.5 + 0.3 (.292'' + .012'')$$

(previously:  $4.5 + 0.3 (.176'' + .012'')$ )

### Important!

The new lockplate cannot be installed on the drive shaft of previous design and vice versa.

17 - Check end play of 2nd, 3rd, and 4th gears. The following limits should not be exceeded.

	Lower Limit	Upper Limit
2nd gear	0.10 mm (0.004'')	0.25 mm (0.0098'')
3rd gear	0.10 mm (0.004'')	0.25 mm (0.0098'')
4th gear	0.10 mm (0.004'')	0.25 mm (0.0098'')

18 - Secure the nut not before the axial adjustment of the drive pinion has been checked.

### Note:

The following modifications have been carried out to eliminate difficulties in engaging second gear.

#### A - From Chassis No. 1—632758

- a - The internal splines of the first gear are beveled at the second gear side (7 degrees).
- b - The clutch teeth of the second gear are also beveled.

#### B - From Chassis No. 1—599151

The synchronizer stop ring has been reshaped and is also beveled at the first gear side.

#### C - From Chassis No. 1—583813

The shifting travel of the second gear has been altered. The distance between the intermediate detent ball undercut and the undercut for the 2nd gear on the 1st-and-2nd selector shaft amounts now to 10 mm (.4"), formerly 8.5 mm (.23"), as measured from center to center of undercuts. The total length of the selector shaft is 207 mm (8.15"), formerly  $208.5 \pm 0.5$  mm ( $8.208 \pm .02''$ ).

#### D - From Chassis No. 1—583187

From the above number, weaker shifting plate springs are used. When carrying out repairs, care should be taken that springs of the same type are used.



Technical Data	Old Type Part No. 305 365	New Type Part No. 305 365a
Thickness of wire	1 mm (.04")	0.85 mm (.033")
Length	11.6 mm (.46")	11.6 mm (.46")
at the load of	4.9 ± 0.34 kg	2.5 ± 0.2 kg
Torsional strength	74.5 kg/sq. mm	60.0 kg/sq. mm

### Important!

Earlier type transmission parts can be replaced as follows:

- a - 1st gear and selector shaft can only be replaced as a pair. The two parts must always be either of the earlier or of the later type.
- b - The 2nd gear and the synchronizer stop ring for the 2nd gear can be replaced separately.

It is recommended to replace all parts mentioned under the points from A to D only when trying to **eliminate difficulties in engaging the 2nd gear** of earlier transmission.

### Note:

To guard against a slipping out of the 3rd or 4th gear, the clutch teeth of the 3rd and 4th gears on the drive pinion shaft have been modified as follows:

- a - On 24 of the 30 clutch teeth up to 0.21 mm (.008") more metal is machined off the coasting side. The six remaining teeth (two groups of three each being diametrically opposite) have not been modified in this way.
- b - The driving sides of all teeth and also the coasting sides of the six teeth are machined to incline by max. 2 degrees from the chamfered end toward the thrust ring.
- c - The 3rd/4th gear operating sleeve will thus only bear on six teeth when coasting in 3rd or 4th.

### Service Instructions

- 1 - A subsequent installation of the 3rd gear train or 4th gear train with altered clutch teeth is only justified after corrections of the gear lever stop plate and selector fork adjustments have failed to effect a cure.
- 2 - Other parts should only be replaced if damaged or worn beyond the wear limit.
- 3 - All parts on the drive pinion shaft up to the 3rd/4th clutch gear are to be assembled on the shaft with pressure ( $122 \pm 0.05$  mm/4.8"  $\pm .002$ "). However, the end play given in the Shop Manual for the individual speed gears on the drive pinion should be adhered to.
- 4 - Carefully adjust the selector fork.
- 5 - The 2nd gear clutch teeth were modified in the same manner at an earlier date.

## Synchromesh Transmission — Needle Bearings

Date introduced: Nov. 11th, 1957

From Chassis No.: 1 726 006

From Rear Axle No.: 1 429 355

As of the above-mentioned date, the synchromesh transmission of the VW Passenger Car will be fitted with two needle bearings to replace the rear ball bearing on the main shaft and the roller bearing on the pinion assembly. Furthermore, gearwheel pairs with a modified tooth ratio will be installed for the 3rd and 4th speed.

- 1 - In place of the roller bearing (Spare Part No. 111307219), a needle bearing (Spare Part No. 113309219) will be fitted on the pinion assembly. Service installation of this needle bearing in transmissions of older design is not possible.
- 2 - A dowel pin (Spare Part No. 113309223) secures the needle bearing in the crankcase bore.
- 3 - A needle bearing (Spare Part No. 113309125) will be fitted in place of the rear ball bearing (Spare Part No. 111307125) on the main shaft. Service installation of this needle bearing in transmissions of older design is not possible.
- 4 - The requisite lock pin (Spare Part No. 113309521 A) serves to retain the needle bearing in the crankcase bore and to secure the reverse sliding gear shaft (Spare Part No. 113309515 B). Offset relative to the center of the bearing bore, this cylindrical pin is no longer accommodated in a bore as heretofore but rests now in a groove in the reverse sliding gear shaft. For this reason the transmission case has been provided with a through-bore for the lock pin. Service installation of the lock pin and of the modified reverse sliding gear shaft in a transmission of older design is not possible. As a general rule, parts of older design cannot be fitted in the new type transmission case.

- 5 - The main shaft (Spare Part No. 113309101 A) is no longer provided with a shoulder to limit the seat of the ball bearing fitted up to now. Service installation of this main shaft in a transmission of older design, or of an old main shaft in a transmission of new design, is not possible.
- 6 - Due to the smaller outside diameter of the two needle bearings, the bearing bores in the transmission case (Spare Part No. 113301031 B) have been reduced in size. In the transmission case web which is wider now, a bore has been provided between the needle bearings to accommodate a hex. head mounting bolt M 7 x 170 (Spare Part No. N 103221). Transmission cases of older design cannot be exchanged for cases of the new design.
- 7 - The bevel gear of the pinion assembly has been shortened by 2 mm on the shaft side because the needle bearing is 2 mm wider than the roller bearing fitted previously. The new pinion assembly has the Spare Part No. 113517141 B. It may be installed in older transmissions with roller bearing or special needle bearing only in conjunction with a 2 mm spacer (Spare Part No. 113309231). The inside chamfer of the spacer has to face toward the bevel gear. Pinion assemblies of older design will be fitted only as long as present stocks last.
- 8 - The clutch gear for the 2nd gear (Spare Part No. 113309233 A) has a small recess on the side facing the needle bearing thus providing sufficient play for the bearing. The modified clutch gear can be fitted in transmissions of older design. However, clutch gears of older design cannot be fitted in transmissions that have needle bearings.
- 9 - In connection with the modification of the clutch gear for 1st and 2nd gear, the overall length of the shifting plates (Spare Part No. 113309239 A) for 1st and 2nd gear has been reduced from 27 mm (1.06'') to 26.5 mm (1.04'') to ensure sufficient play for the needle bearing. Shifting plates of the former design may be replaced by plates of new design but plates of the new design cannot be replaced by old ones.
- 10 - In place of the 0.1 mm (.0039'') and 0.15 mm (.0059'') thick shims (Spare Part Nos. 113309225/227) between needle bearing (Spare Part No. 113309219) and clutch gear for 2nd gear (Spare Part No. 113309233 A), shims of a smaller outside diameter (Spare Part Nos. 113309225 A/227 A) are now fitted. The large shims continue to be used for transmissions of older design.
- 11 - Modified gearwheel pairs (Spare Part Nos. 113309275 A/341 A) are now being fitted for the 3rd and 4th speed in place of the pairs (Spare Part Nos. 113309275/341) which had tooth ratios of 22 : 27 and 27 : 22. The new wheels have tooth ratios of 23 : 28 and 28 : 23. They may also be used in transmissions of older design. When installing special needle bearings, the new gearwheels have to be fitted, too (please see Workshop Bulletin H/125).
- 12 - To mark the transmissions with needle bearings, an "N" is punched into the transmission case next to the transmission number.

#### Attention

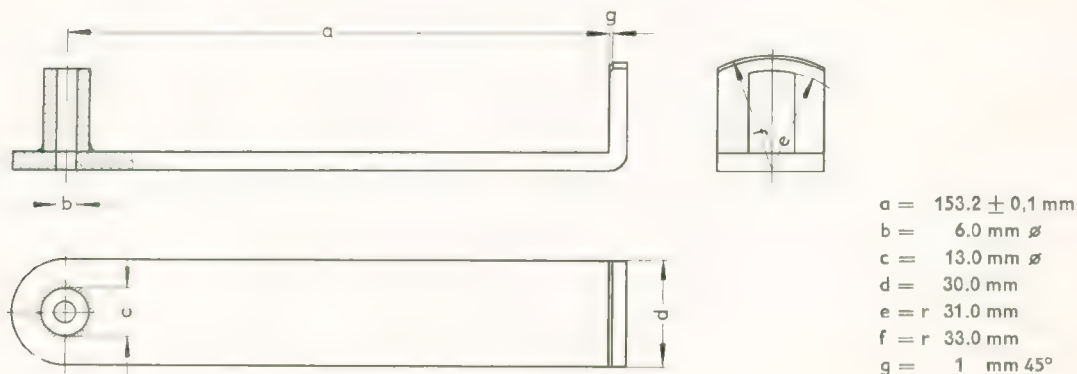
Magnetic oil drain plugs (Spare Part No. 111101197) should be service-fitted whenever transmissions not yet equipped with such plugs are brought in for repairs. These magnetic oil drain plugs are also available in oversize (Spare Part No. 111101199). Their efficiency depends to a considerable degree on proper and regular cleaning.

## Synchromesh Transmission — Service Installation of Special Needle Bearings

Whenever necessary, it is possible in the synchromesh transmissions to replace the radial ball bearing on the main shaft and the cylindrical roller bearing for the drive pinion (rear) by special needle bearings. The radial ball bearing on the main shaft (front) may be replaced by a tapered roller bearing. Furthermore, 3rd and 4th speed gear wheel pairs with a modified gear ratio have to be fitted in order to ensure continued quietness of operation in these speeds after needle bearings have been installed.

The following points should be observed for service installation:

- 1 - The radial ball bearing on the main shaft (rear), Spare Part No. 111307125, should be replaced by a special needle bearing, Spare Part No. 113309125 A. This needle bearing has the same outside diameter as the radial ball bearing. The main shaft does not have to be replaced if the seating surface for the needle bearing is in proper condition.
- 2 - A longer locking pin (Spare Part No. 113309521 B) has to be used to secure the needle bearing and the reverse sliding gear shaft. The faced reverse sliding gear shaft (Spare Part No. 113309515 A) may continue to be used.
- 3 - The radial ball bearing on the main shaft (front), Spare Part No. 113309123 may be replaced by a tapered roller bearing, Spare Part No. 211309123, with split inner race.
- 4 - The cylindrical roller bearing for the drive pinion (rear), Spare Part No. 111307219, is to be replaced by a needle bearing, Spare Part No. 113309219 A. Due to the greater thickness of the outer race, this needle bearing has the same outside diameter as the cylindrical roller bearing.
- 5 - This needle bearing is to be secured in the transmission case bore by means of a cylindrical pin (Spare Part No. 113309223). For this purpose, a hole of 6.0 mm  $\varnothing$  should be drilled in the seat for the needle bearing at a distance of  $153.2 \pm 0.1$  mm from the contact surface for the locking ring of the double-race ball bearing (Spare Part No. 111307375). Measured from the case partition, this hole should be  $39.0 \pm 0.3$  mm deep. If necessary, the bore for the cylindrical pin should then be reamed to a diameter of 6.00/6.12 mm. The requisite gauge shown below can be made at the workshop.



- 6 - The drive gear set does not have to be replaced. However, if the old set is damaged, a new one (Spare Part No. 113517141 B) is used with a 2 mm thick spacer (Spare Part No. 113309231) fitted between the bevel gear of the pinion and the needle bearing and the inside chamfer facing toward the bevel gear. The reason for this arrangement is that the bevel gear engaging this pinion is 2 mm shorter on the shaft side. In all other respects the instructions given under points 4,7 and 8 apply also to the installation of this gear set. After available stocks have been exhausted, the gear sets used up to now will no longer be fitted as the new set (Spare Part No. 113517141 B) can be subsequently installed with the spacer (Spare Part No. 113309231) in all transmissions of olger design.
- 7 - The shims (Spare Part No. 113309225/227) between cylindrical roller bearing and 2nd speed clutch gear (synchronizing unit) should be replaced by shims of smaller outside diameter. These shims are 0.1 mm and 0.15 mm thick and have the Spare Parts No. 113309225 A. They are to be inserted, according to requirement, between needle bearing and clutch gear in such a manner that all parts on the pinion up to 3rd/4th speed clutch gear (Spare Part No. 113309309) protrude up to 0.05 mm beyond the splined ends of the pinion i. e. that they are press-fitted.

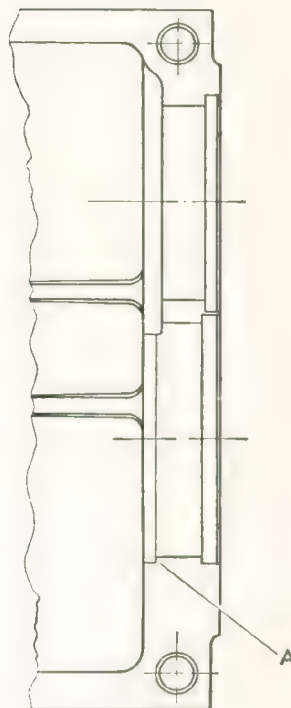


8 - The 2nd speed clutch gear (synchronizing unit), Spare Part No. 113309233, and the 1st/2nd speed shifting plates (Spare Part No. 113309239) do not need to be replaced.

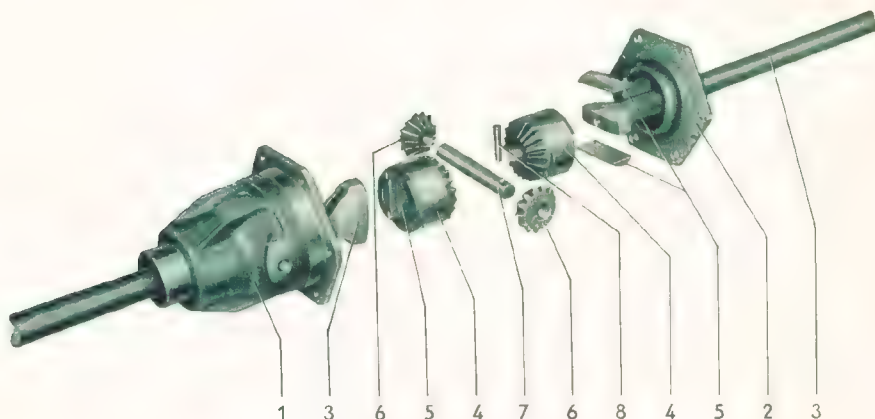
9 - The 3rd and 4th speed gear wheel pairs (Spare Part Nos. 113309275/341) with gear ratios of 22 : 27 and 27 : 22 have to be replaced by modified pairs (Spare Part Nos. 113309275A and 113309341A) with ratios of 23 : 28 and 28 : 23. After installation, check with the transmission case open whether or not the 4th speed gear on the pinion at the bottom of the case partitions runs freely and without interference on the shift gear housing side. If it does not, it will be necessary to rework the housing at the spot indicated (A).

#### Attention

Take advantage of all transmission repairs to fit magnetic oil drain plugs (Spare Part No. 111101197) which are also available in over-size (Spare Part No. 111101199). Their efficiency depends to a considerable degree on prompt and regular cleaning.



## Reconditioning Differential



1 - Housing  
2 - Cover  
3 - Rear Axle Shaft  
4 - Differential Side Gear

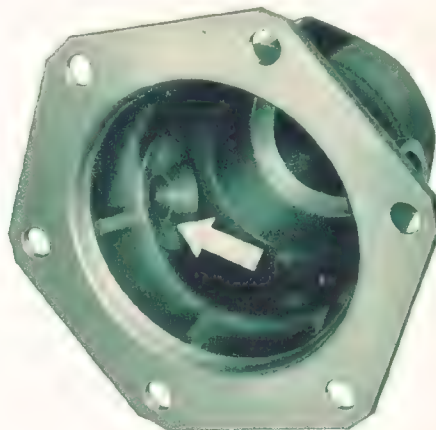
5 - Fulcrum Plates  
6 - Differential Pinion  
7 - Differential Pinion Shaft  
8 - Lock Pin

### Disassembly

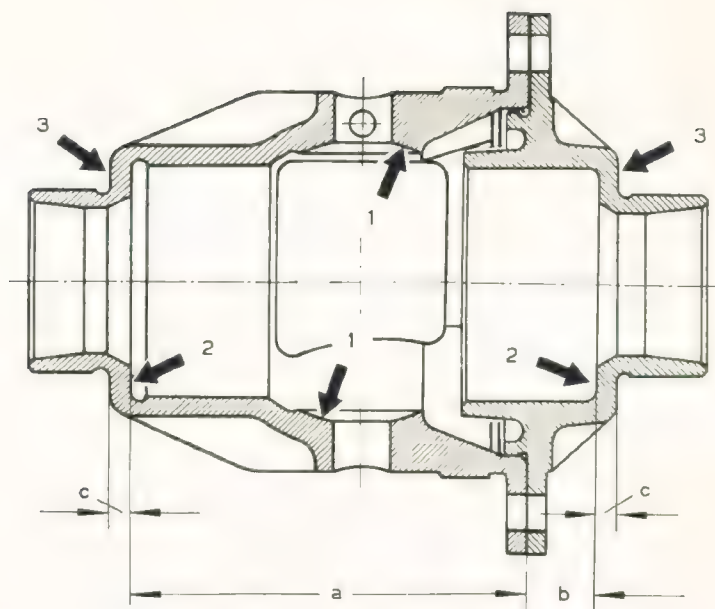
- 1 - Open transmission case and remove differential and rear axle shafts.
- 2 - Place differential in holding fixture VW 314.
- 3 - Remove lock wire and ring gear retaining screws.
- 4 - Take off differential housing cover, rear axle shaft, differential side gear and fulcrum plates.
- 5 - Lift off ring gear.
- 6 - Remove lock pin of differential pinion shaft.
- 7 - Take off differential pinion shaft and differential pinions.
- 8 - Lift off rear axle shaft, differential side gear and fulcrum plates from differential housing.

### Inspection

- 1 - Check concave differential pinion contact surface in differential housing for wear. If wear is apparent, replace differential housing. The distance between the contact surfaces must be between 80.046 mm and 80.000 mm (3.1514" and 3.1496").



- 4 - Take off differential housing cover, rear axle shaft, differential side gear and fulcrum plates.
- 5 - Lift off ring gear.



- 1 - Contact surface for differential pinion
- 2 - Contact surface for differential side gear
- 3 - Contact surface for differential shim

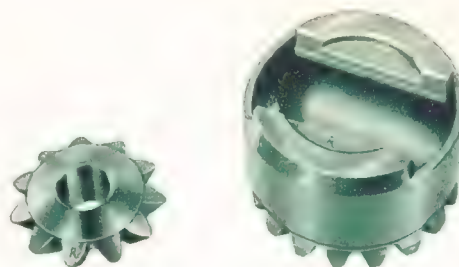
- a - Depth of differential housing 109 mm (4.29")
- b - Depth of differential housing cover 19 mm (0.75")
- c - Minimum thickness of wall 4.0 mm (0.16")

- 2 - Inspect differential housing and cover for wear on contact surfaces for differential side gears and differential shims. Replace if necessary.

It is permissible to remachine the contact surfaces but care must be taken not to remove more metal than prescribed by dimension c on the drawing.

- 3 - Check rear axle shafts and differential components for evidence of damage and wear. Replace, if necessary, after having observed the following points:

- a - A replacement of the differential side gears and pinions requires attention to the matching instructions. The differential gears are marked according to the various cutting methods.



- Group 1: Gleason  
Klingelnberg  
Klingelnberg (altered)

G } These  
K } marks are  
V } not always  
present

- Group 2: Revacycle method

R

#### Attention!

When replacing differential gears, only those of the same cutting method must be matched.



- b - The number of teeth of differential gears are at a modulus of 3.9:

Differential side gear ..... 17 teeth  
Differential pinion ..... 11 teeth

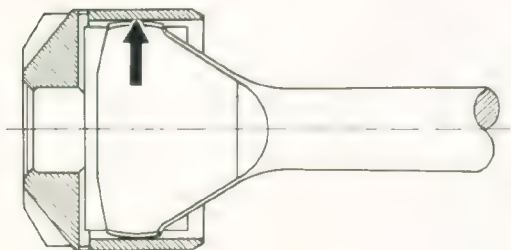
Only gears of the same modulus must be fitted to one differential.

**Note:**

The differential pinion shaft (Part No. 111517177) has been provided with two flat sides at the contact faces for each of the differential pinions from Chassis No. 1483446 and in series production from Chassis No. 1600440. This alteration has been carried out to improve lubrication.

Stocks of differential pinion shafts not provided with the flat sides may be used up.

- c - The fitting clearance between the flat end of the rear axle shaft (measured across the ball-shaped sides) and the inner diameter of the differential side gear is between 0.03 and 0.1 mm (0.0012" and 0.004").



Rear axle shafts and differential side gears fall into three groups and are mated in accordance with the prescribed tolerances.

Paint Mark	Side Gear Inner Diameter	Axle Shaft Outer Diameter
Blue	59.97—60.00 mm (2.3610"—2.3622")	59.90—59.94 mm (2.3582"—2.3598")
Pink	60.01—60.04 mm (2.3625"—2.3637")	59.95—59.97 mm (2.3602"—2.3610")
Green	60.05—60.07 mm (2.3641"—2.3649")	59.98—60.00 mm (2.3614"—2.3622")

The paint mark of the side gear is found on the recessed face in the form of a dot. The axle shaft is marked by a ring painted 150 mm (6") from the flat end.

Excessive clearance may lead to a noisy operation of the rear axle shaft.

- 4 - Check rear axle shaft for run-out at ball bearing seat, the allowable run-out being 0.05 mm (0.002"). If the run-out is slightly in excess of this value, straighten rear axle shaft in Repair Press VW 400 in conjunction with VW 405 and VW 406 in cold condition.

- 5 - Inspect ring gear for wear and damage. If necessary, replace ring gear and drive pinion as a pair. (Note matching number.)

## Assembly

- 1 - The differential housing should be thoroughly oiled before assembly.
- 2 - Check fitting clearance of rear axle shaft/fulcrum plates/differential side gear. In the case of excessive clearance, fit oversize fulcrum plates marked by a groove on their faces, or replace worn parts.



**Note:**

From Chassis No. 1170815 the fulcrum plates inside the differential of all current production cars are copper plated. These fulcrum plates are of standard size and replace those of previous design which are no longer available as spares.

Copper-plated fulcrum plates can be incorporated in earlier cars as a remedy for grinding noises audible when reversing at low speed. As is already known, these noises have no bearing on the life and dependability of the rear axle, so that normally no actions are necessary.

3 - The lock pin for the differential pinion shaft should be peened in position.

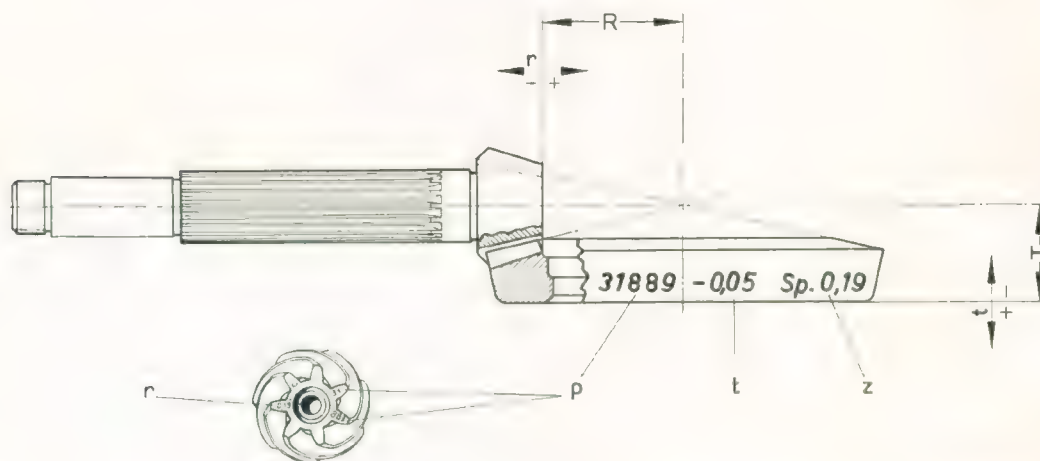
4 - Keep the contact surfaces of the differential housing and ring gear absolutely clean to insure an even backlash.

5 - Tighten ring gear retaining screws to a torque of 6 mkg (45 ft. lbs.) and secure them with a piece of wire.

#### Important!

The wire should be threaded through the holes in a way which insures a right-hand tension on all screws when intertwining its end.

## Adjustment of Drive Pinion and Ring Gear (Crown Wheel)



p = Matching number

T = Distance from drive pinion center line to ring gear back face (constant value 40.00 mm/1.575")

f = Departure from T

R = Distance from ring gear center line to drive pinion face (see table below)

r = Departure from R

z = Backlash (mm)

	Klingelnberg 7 : 31		Gleason	
	m = 3,00	m = 3,25	7 : 31	8 : 35
Designation	K	V	—	—
R	59.22	59.22	59.35	55.75

Silent operation and minimum wear of the final drive depend on the proper adjustment of drive pinion and ring gear. Drive pinions and ring gears are machined in pairs to very close limits. A rigid inspection by means of special testing appliances assures proper tooth contact and silent meshing in both turning directions. Both the drive pinion and the ring gear can be moved to secure proper adjustment. Departures from the normal position and the correct backlash (Sp) are measured and written on the drive pinion or ring gear respectively. Each pair of drive pinions and ring gears are provided with a matching number. It is not permissible to replace a drive pinion or ring gear separately.

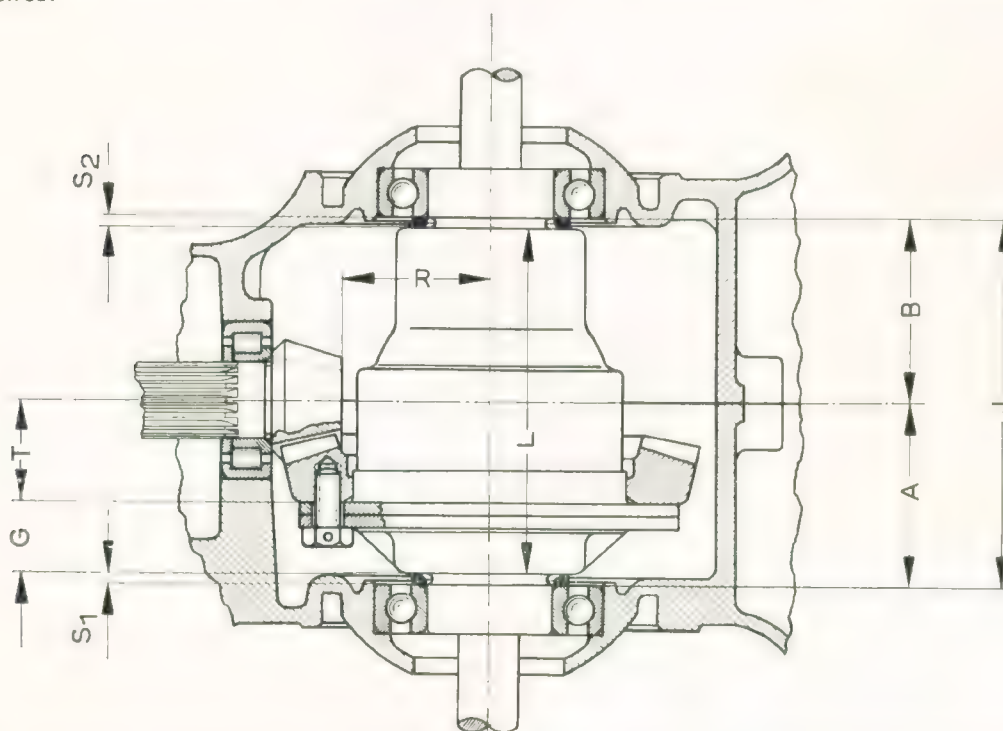
The object of the rear axle adjustment is to obtain the same favourable gear meshing as determined in the factory by precision testing machines. This is facilitated by the values written on the gears.

The correct position is determined by the distance from the drive pinion center line to the ring gear and the distance from the ring gear center line to the drive pinion. A proper adjustment requires attention to the following pages.

## Fundamental Hints of Ring Gear (Crown Wheel) Adjustment

The crown wheel is attached to the differential housing by screws. Adjustment is effected by two shims, one on each side of the differential housing. The proper thicknesses of the shims are determined after having measured the required dimensions.

To determine the thicknesses of the shims, "S 1" and "S 2" on the drawing, the following dimensions are required:



Designation	Measurements	Standard
A*	Depth of left transmission case half	72.55 mm (2.8563")
B	Depth of right transmission case half	72.55 mm (2.8563")
J	Total depth of transmission case	145.10 mm (5.7126")
L	Length of differential housing	138.00 mm (5.4331")
G	Distance from ring gear back face to shim contact face	28.95 mm (1.1398")

\* Not required, if using test mandrel VW 289b.



The readings should be taken precisely to 0.01 of a millimeter (0.0004 of an inch.). The dimension T (distance from drive pinion center line to crown wheel back face) is constant and amounts to 40.00 mm (1.575'').

When determining the shims, the plus or minus marking t on the crown wheel must be taken into account.

The preload V on the two differential ball bearings should be within 0.10 and 0.18 mm (0.004'' and 0.007'').

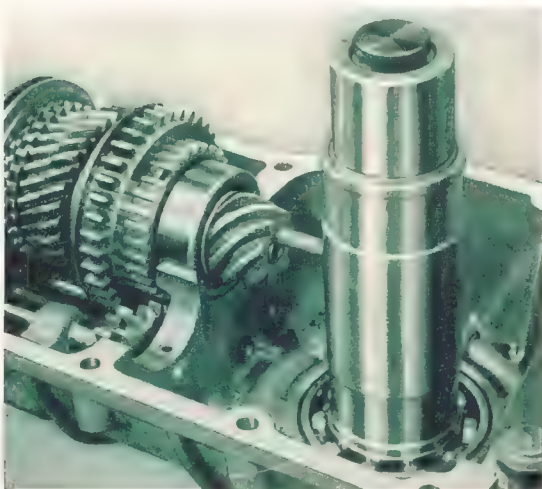
Thus, with a mean value of 0.14 mm (0.0055''), it is necessary to add  $\frac{V}{2} = 0.07 \text{ mm (0.0027'')}$  to each shim.

## Adjusting Ring Gear with VW Measuring Devices

To be sure of accurate readings, the surfaces with which the measuring devices make contact must be absolutely clean and not damaged. The differential ball bearings must seat squarely on the bottom of their recesses.

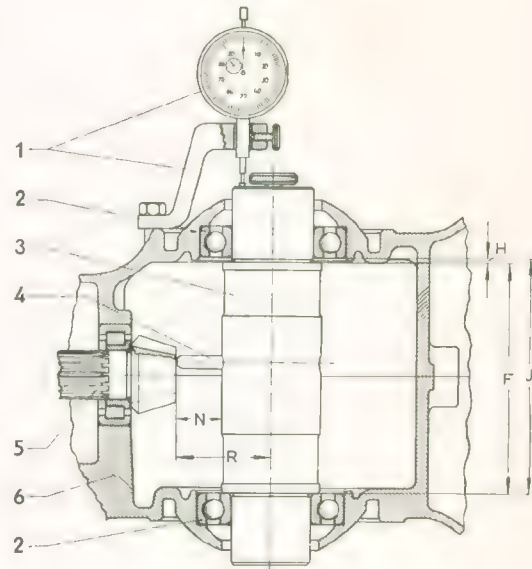
### Total Depth of Transmission Case J

- 1 - Place drive pinion in left transmission case half and take up end play by tapping it toward the differential chamber with a light-metal hammer.
- 2 - Insert mandrel VW 289b in differential ball bearing of left transmission case half.
- 3 - Push tracer pin into mandrel and lock it by means of the knurled-head screw so as to make sure that the tracer pin does not touch the drive pinion.



- 4 - Place right transmission case half on left half and tighten by means of four screws.

- 5 - Attach dial indicator as shown below and adjust it to zero on the mandrel.



1 - Dial indicator and bracket

2 - Ball bearings

3 - Mandrel

4 - Tracer pin

5 - Drive pinion

6 - Transmission case

F - Length of mandrel

H - Measured value (deflection of needle when turning transmission case by 180°)

J - Total depth of transmission case

N - Length of tracer pin

R - Distance from ring gear center line to drive pinion face

6 - Turn transmission case 180°. The axial movement of the mandrel against the ball bearing in the right transmission case half is indicated by the deflection of the needle. The total depth J is obtained by adding the indicated value to the length of the mandrel.

**Example:**

F	=	143.50 mm
+ H	=	1.70 mm
<hr/>		
J	=	145.20 mm

7 - After the depth of the transmission case has been measured, distance R for the axial adjustment of the drive pinion should be checked before removing the mandrel.

**Depth of right transmission case half B**

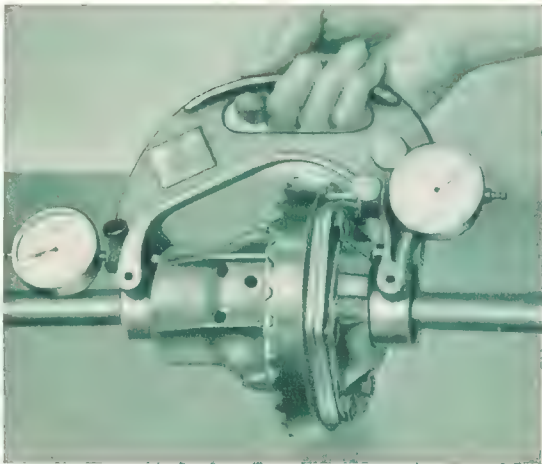
This dimension is to be ascertained by a ruler and a depth micrometer or a depth gauge.

It is recommended to repeat the measuring at three points of the ball bearing inner race and ascertain the mean value.

**Length of the differential housing L and distance from ring gear back face to shim contact face G**

1 - Adjust dial indicators of gauge VW 287 to zero, using the master gauge.

2 - Place gauge on differential housing. The readings obtained are to be added to or subtracted from the standard dimensions according to the deflections of the needles.



**Example:**

Standard dimension for	L	=	138.00 mm
Reading .....		= -	0.15 mm
Actual dimension of	L	=	137.85 mm

Standard dimension for	G	=	28.95 mm
Reading .....		= -	0.05 mm
Actual dimension of	G	=	28.90 mm

**Emergency Method of Adjusting Ring Gear**

If the gauges VW 287 and VW 289 b are not available the measuring can be done with ruler, depth gauge, and caliper square.

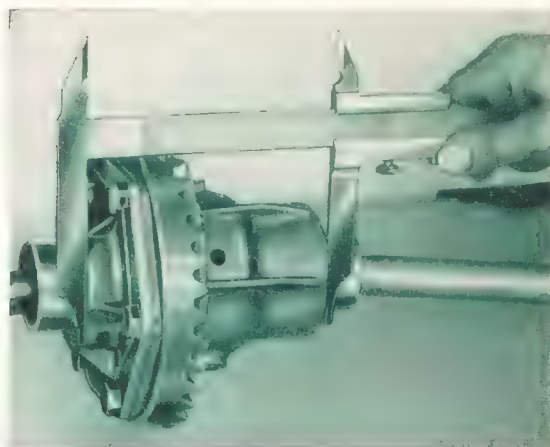
**Total Depth of Transmission Case J**

- 1 - Measure left and right transmission case halves A and B with ruler and depth gauge.
- 2 - The depth gauge is to make contact with the inner race of the ball bearing. Repeat the measuring at different points.
- 3 - Add the measured values of A and B to obtain the total depth J of the transmission case.



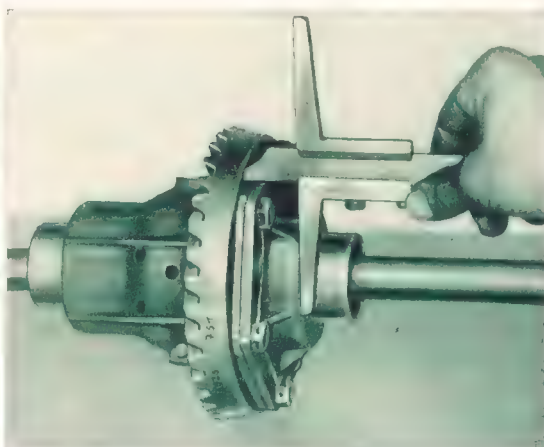
### Length of Differential Housing L

The length of the differential housing is measured with a caliper square.



### Distance from Ring Gear Back Face to Shim Contact Face G

This distance is measured with a depth gauge.



## How to Determine Thicknesses of Shims

The thicknesses of the two differential shims (S 1 and S 2) are determined as illustrated by the following example.

$$\text{Formula: } S1 = J - B - (T \pm t) - G + \frac{V}{2}$$

$$S2 = J - L + V - S1$$

### Example:

#### 1 - Differential shim S 1

J Total depth of transmission case .....	145.20 mm
— B Depth of right transmission case half .....	— 72.65 mm
	72.55 mm
— (T ± t) T Distance from drive pinion center line to ring gear back face .....	40.00 mm
— t departure from T (plus or minus marking on ring gear) .....	— 0.05 mm
	39.95 mm
	— 39.95 mm
	32.60 mm
— G Distance from ring gear back face to shim contact face .....	— 28.90 mm
	3.70 mm
+ $\frac{V}{2}$ Half the preload on ball bearing .....	+ 0.07 mm
S 1 Thickness of left differential shim .....	= 3.77 mm



## 2 - Differential shim S 2

J Total depth of transmission case .....	145.20 mm
— L Length of differential housing.....	— 137.85 mm
	7.35 mm
+ V Preload.....	+ 0.14 mm
	7.49 mm
— S 1 Thickness of left shim .....	— 3.77 mm
S 2 Thickness of right shim .....	= 3.72 mm

A selection of shims is available in the thicknesses from 2.9 to 4.5 mm (2.9, 3.0, 3.1, 3.2, 3.3, etc.). Additionally, shims of the thickness 0.25 mm are available to provide for adjustments in units of 0.05 mm.

The shim thicknesses determined are to be increased or reduced to the next dimension which conforms with the shims available, but the total shim thickness of S 1 and S 2 must remain within the permissible tolerance to ensure that the two differential ball bearings are properly preloaded; e. g.

Determined shim thicknesses: S 1 = 3.77 mm; S 2 = 3.72 mm; S 1 + S 2 = 7.49 mm

Approximate shim thicknesses: S 1 = 3.80 mm; S 2 = 3.70 mm; S 1 + S 2 = 7.50 mm

Check thickness of shims with micrometer, measuring at four different points. Permissible departure 0.03 mm. Before measuring, make sure there is no burr at the shim.

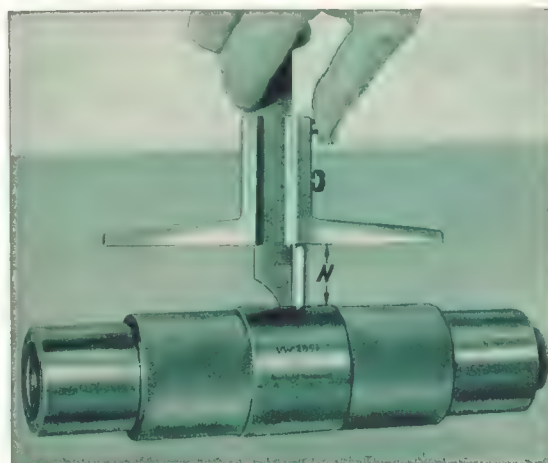
## Adjusting Drive Pinion

### General

The basic adjustment has already been carried out in assembling the drive pinion by the fitting of shims as detailed under the heading "Reconditioning Drive Pinion".

### Adjustment

- 1 - The distance for the axial adjustment of the drive pinion should be measured by the mandrel VW 289b immediately after the total depth of the transmission case (J) for the ring gear adjustment has been measured.
- 2 - Turn the mandrel until the arrow points to the gearshift housing. Loosen knurled-head screw so that the tracer pin makes contact with the drive pinion face.
- 3 - Tighten knurled-head screw and turn mandrel 90° to avoid the position of the tracer pin becoming altered when opening transmission case.
- 4 - Remove mandrel and measure length of tracer pin N with a depth gauge.
- 5 - Add half the diameter (radius) of the mandrel to the measured length of the tracer pin. The



value obtained must correspond to the distance R after the tolerance discrepancy r (plus or minus marking on drive pinion face) has been added or subtracted. Care should be taken, however, to make sure that a minus amount is added to and a plus amount subtracted from distance R (see example below).

**Example:**

a - Standard dimension of R .....	59.22 mm
Tolerance discrepancy $r = -0.18$ mm	
Insert .....	$+ 0.18$ mm
Fitting dimension .....	59.40 mm
Rounded off .....	59.4 mm
b - Radius of mandrel .....	30.00 mm
Length of tracer pin .....	29.6 mm
Dimension measured .....	59.6 mm

In comparing the value measured (59.6 mm) with the fitting dimension (59.4 mm), it will be found that the total thickness of the drive pinion shims must be increased by 0.2 mm.

**Note:**

The measuring of the drive pinion axial adjustment with mandrel VW 289b does not render unnecessary a check of the tooth contact.

**Klingelberg Tooththing**

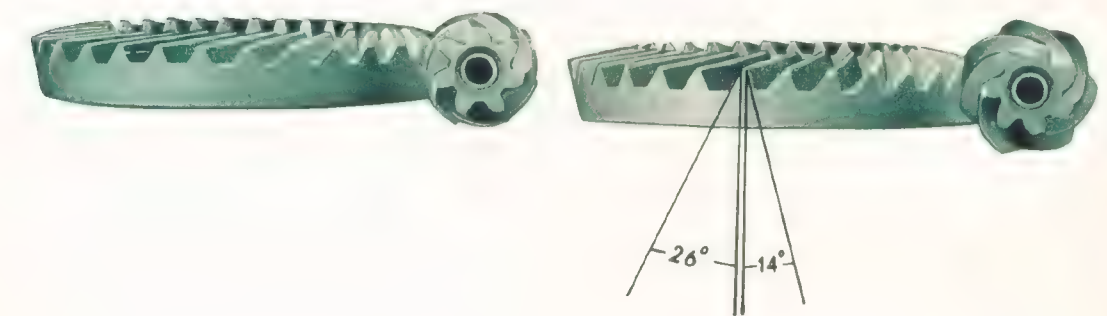
From Chassis No.1258990, apart from the usual set (modulus:  $m = 3.00$ ), the standard and synchromesh transmissions will also be equipped with Klingelberg drive pinions and ring gears having a tooth ratio of 7 : 31 and a modulus of 3.25. This modification is to increase the strength of drive pinion and ring gear.

**Gleason Tooththing**

From Chassis No.1193483 Gleason gear sets — ratio of teeth 7 : 31 — are being installed. The following points should be noted when installing this gear set — ratio of teeth 7 : 31 (formerly 8 : 35):

**Difference between the old and the new sets**

- a - The drive pinion of the new Gleason gear set with its 30 mm (1.18") is about 3.5 mm (.14") longer than the earlier Gleason and the current Klingelberg pinions.
- b - The ring gear (crown wheel) with its 26.5 mm (1.04") is about 1.5 mm (.06") wider than that of the earlier types.
- c - The tooth meshing angle is non-symmetrical. On the driving side it is 14 degrees and on the coasting side 26 degrees. The earlier Gleason and the current Klingelberg gear sets have a symmetrical meshing angle. Therefore, the new Gleason set is distinguished from other sets by its "saw-tooth".



	$m = 3.00$	$m = 3.25$
Distinguishing mark (drive pinion face):	K	K
Distinguishing mark (ring gear):	None	V
Nominal dimension for "R" (distance from ring gear center line to drive pinion face):	59.22 mm (2.3315")	59.22 mm (2.3315")

**Adjusting the Drive Pinion**

Nos. of teeth	7	8
R	55.75	59.35

## Checking Adjustment of Drive Pinion and Ring Gear

Make sure the axial adjustments of drive pinion and ring gear are correct by measuring the backlash and checking the tooth contact.

### Preliminary Operations

- 1 - Place differential in left transmission case half, taking care that the two differential shims are fitted to the correct sides. The chamfered face of the shim must be toward the differential housing. If an additional shim of 0.25 mm is required, it should be fitted between ball bearing and other shim.

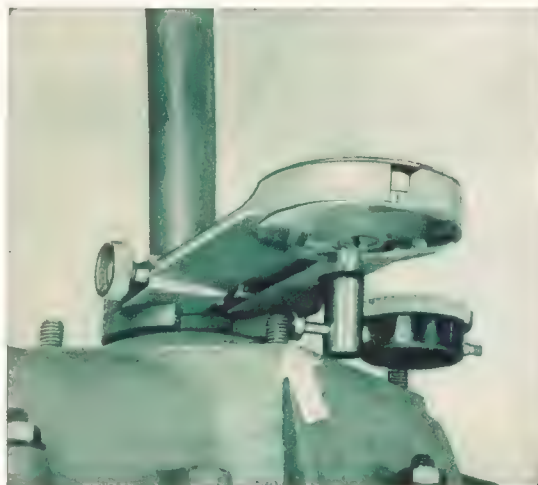
- 2 - Put drive pinion in place and tap it toward the ring gear by a light-metal hammer to take up any end play.

- 3 - Gleason toothing: Paint the teeth of the ring gear with a light paste made of dry red lead and engine oil.

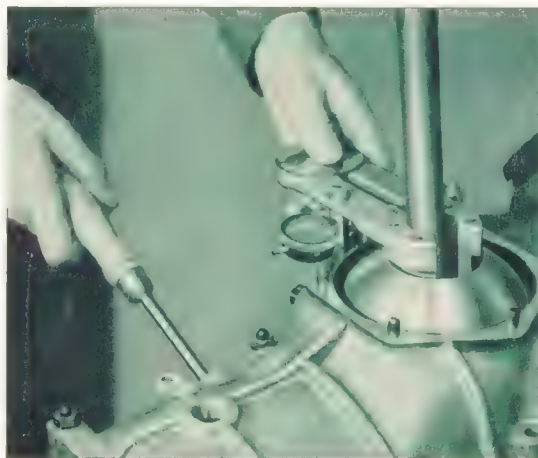
Klingelnberg toothing: Paint the teeth of the drive pinion with the aforementioned paste.

- 4 - Fit the right transmission case half and tighten it by six screws.

- 5 - Attach gearshift housing to transmission case (Note specified preload).



- 2 - Prevent movement of the drive pinion and lightly move the gauge to take up the play in both directions. The amount of backlash will be indicated by the deflecting needle.



- 3 - Repeat the measuring several times, each time turning the ring gear 90°. The values measured must not differ from one another by more than 0.05 mm (0.002''). Compare the backlash measured with the amount of backlash written on the ring gear.

### Measuring Backlash

- 1 - Insert the gauge VW 288b in the differential housing so that the tracer of the dial indicator contacts one of the studs for the axle tube retainer. Lock the gauge in this position.

- 4 - An undue departure from the prescribed backlash should be corrected by altering the shims S 1 and S 2, but the total thickness of the shims must be maintained. Then recheck the backlash.



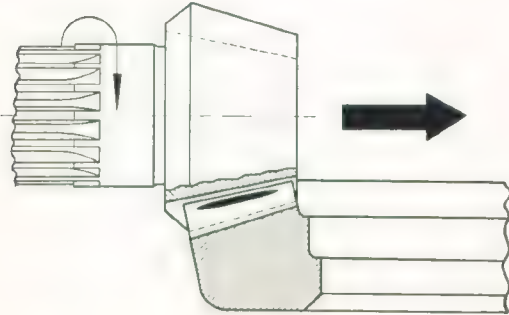
### Checking Tooth Contact

1 - Rotate the differential and ring gear in both directions at the rear axle shafts.

2 - Open transmission case.

#### 3 - Gleason Tothing

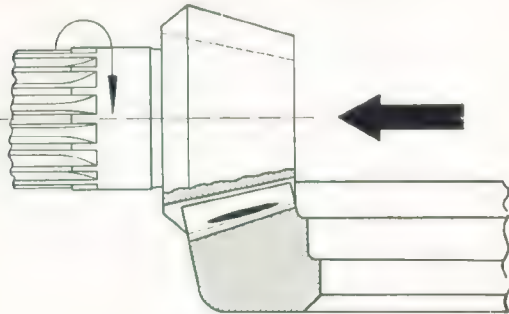
Check impression of **ring gear** tooth contact; if necessary, correct the axial adjustment as indicated below and repeat the test.



#### High tooth contact.

This condition is caused by the drive pinion being too far away from the ring gear and is corrected by increasing thickness of the pinion shims.

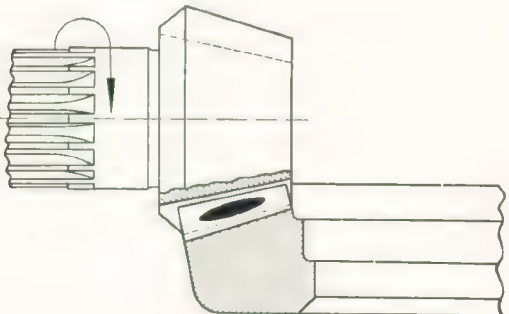
Recheck backlash and correct if necessary.



#### Low tooth contact.

This indicates that the pinion is too far in mesh with the ring gear. Reduce the thickness of the pinion shims.

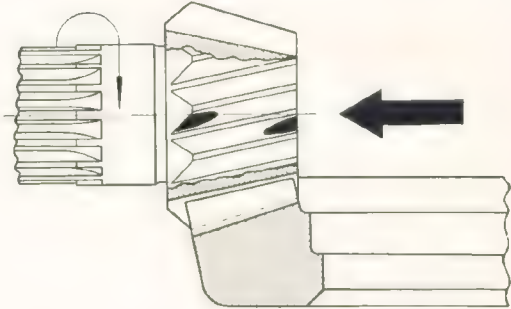
Recheck backlash and correct if necessary.



#### Proper tooth contact.

#### 4 - Klingelnberg Tothing

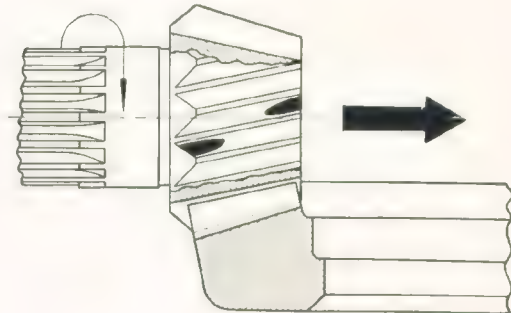
Check impression of **drive pinion** tooth contact; if necessary, correct the axial adjustment as indicated below and repeat the test.



#### Contact at larger diameter (driving side).

This indicates that the pinion is too far towards the ring gear. Reduce the thickness of the pinion shims.

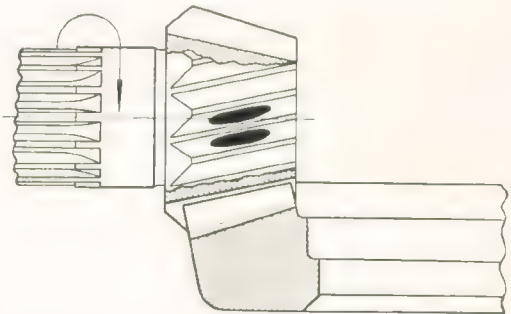
Recheck backlash and correct if necessary.



#### Contact at smaller diameter (driving side).

This condition is caused by the drive pinion being too far away from the ring gear and is corrected by increasing thickness of the pinion shims.

Recheck backlash and correct if necessary.



#### Proper tooth contact.

## Removing and Installing Gearshift Lever

### Removal

- 1 - Remove screws that attach the gearshift lever ball housing to the frame tunnel.
- 2 - Take off gearshift lever, spring, and stop plate.
- 2 - When installing stop plate, make sure that the turned up edge is on the right-hand side.



- 3 - Clean all components.

### Installation

Reverse the above operations and observe the following points:

- 1 - Check gearshift lever, stop plate, and shifting rod end for wear. Replace worn parts.
- 2 - Grease all moving parts with Universal Grease VW — A 052.
- 3 - The gearshift lever ball housing must occupy a position which insures that the gearshift lever stands vertical in neutral position. The stop plate must be embraced by the hollow flange of the ball housing.
- 4 - Check condition of gearshift lever rubber boot, replace it if necessary.
- 5 - Check position of gearshift lever by engaging the gears. If necessary, correct the position.



## Removing and Installing Shifting Rod

### Removal

- 1 - Remove gearshift lever.
- 2 - Remove rear seat.
- 3 - Remove inspection cover on frame tunnel.
- 4 - Remove lock wire at the coupling screws and release the front screw.
- 5 - Open front bonnet and remove spare wheel.
- 6 - Remove front bumper.

7 - Remove frame head cover.

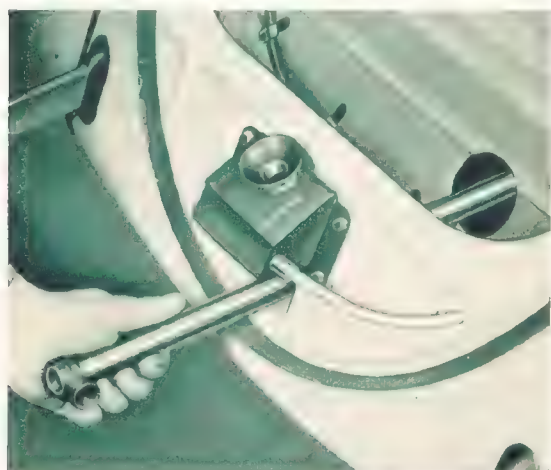
8 - Unhook brake cables.

Remove guide plate for brake push bar after having removed the two screws.

9 - Withdraw shifting rod from the coupling, using combination pliers, and push it toward the front of the car as far as possible so that it can be gripped at the front by the pliers.



10 - Withdraw shifting rod through the openings in the body.



## Installation

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

1 - Check shifting rod for wear and twist. Wear may be caused by the leaf spring in the frame tunnel. Replace shifting rod if necessary.

The vertical end for accepting the gearshift lever and the recess for the coupling screw must be in line to avoid shifting difficulties.

2 - Grease the entire shifting rod with Universal Grease VW — A 052.

3 - Insert the shifting rod in the guide situated in the frame tunnel behind the opening for the gearshift lever. This operation is facilitated by the assistance of a second mechanic.

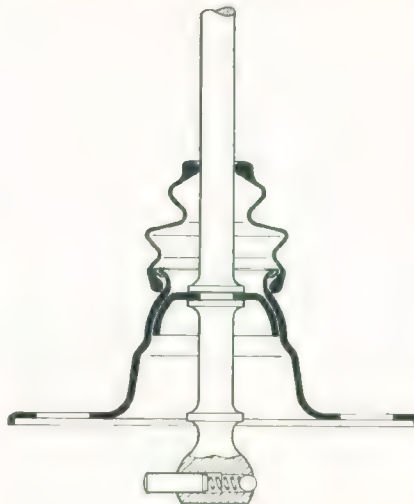
4 - Connect shifting rod coupling and secure with a piece of wire.



## Gearshift Lever Removal and Installation

### Removal

- 1 - Remove screws that attach the gearshift lever ball housing to the frame tunnel.
- 2 - Take off gearshift lever, ball housing, rubber boot, and spring as a unit. The spring should be turned for removal to clear the pin.



- 3 - When installing stop plate, make sure that the turned-up edge is on the right-hand side.

- 3 - Take off stop plate.
- 4 - Clean all components.

### Installation

Reverse the above operations and observe the following points:

- 1 - Check gearshift lever collar, stop plate, and gearshift lever ball socket in shifting rod for wear. Replace worn parts.
- 2 - Make sure the gearshift lever locating pin is secure. Replace if necessary.



### Note:

From Chassis No. 1—0948000 a modified gear lever has been installed.

The spring-loaded ball is to prevent a rattling noise of the gear lever in its socket.

Only this improved gear lever will henceforward be delivered by the Parts Department.

It has the same Part No. as the one in use from 4th August 1955 onwards and can only be exchanged for this.

- 4 - Grease all moving parts with Universal Grease VW — A 052.

- 5 - The gearshift lever ball housing must occupy a position which insures that the gearshift lever lower (straight) portion stands vertical in neutral position and the gearshift lever

locating pin engages in the slot provided in the ball socket.



The stop plate must be embedded in the hollow flange of the ball housing.

6 - Check condition of gearshift lever rubber boot, replace if damaged.

7 - Check position of gearshift lever by engaging the gears. Correct if necessary.

## Shifting Rod Removal and Installation

### Removal

- 1 - Remove gearshift lever.
- 2 - Remove rear seat.
- 3 - Remove inspection cover on frame tunnel.
- 4 - Remove lock wire at the coupling screws and release front coupling screw.
- 5 - Open the front hood and take off spare wheel.
- 6 - Remove front bumper.
- 7 - Remove frame head cover.
- 8 - Withdraw shifting rod from the coupling, using combination pliers, and push it toward the front of the car as far as possible so that it can be gripped at the front with the pliers.
- 9 - Completely withdraw shifting rod through the openings in the body.

### Installation

This is accomplished by reversing the preceding operations, but attention should be paid to the following points:



- 1 - Check shifting rod for wear and twist. Wear may be caused by the leaf spring in the frame tunnel. Replace shifting rod if necessary.
- 2 - Coat the entire shifting rod with Universal Grease VW — A 052.
- 3 - Insert the shifting rod in the guide situated in the frame tunnel behind the opening for the gearshift lever. This operation is facilitated by the assistance of a second mechanic.

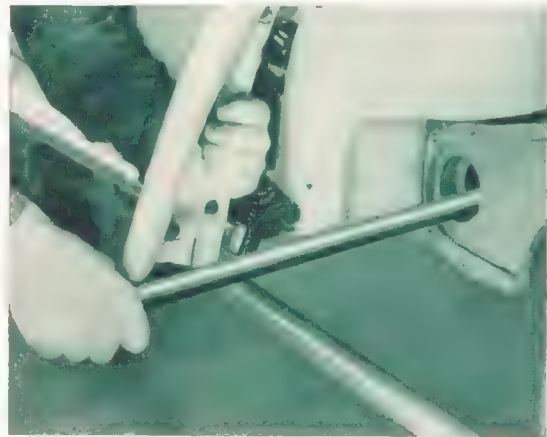
## General Description

The rear wheels are sprung independently. The inner ends of the two torsion bars are anchored in the center of the frame cross member by a splined tube which is welded in position. The outer ends of the torsion bars, which are also provided with splines, carry the spring plates, the hubs of which are rubber-cushioned. The rear axle tubes are attached to the rear ends of the spring plates. The suspension is adjustable by means of the splines. Double-acting telescopic shock absorbers prevent excessive rebound.

## Removing and Installing Torsion Bar

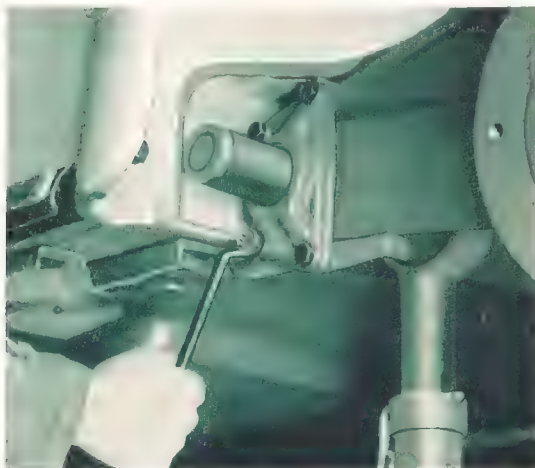
### Removal

- 1 - Loosen rear wheel mounting bolts.
- 2 - Support car on trestles in a horizontal position and remove rear wheel.
- 3 - Remove screws at rear axle shaft bearing housing for axle tube and shock absorbers.
- 4 - Pull rear axle towards the rear until it clears the spring plate.
- 5 - Take off torsion bar hub cap after having removed the cotter pin.
- 6 - Remove screws that attach spring plate hub cover and take off cover.



### Note:

In the case of a broken torsion bar, push the broken end from the splined center anchor by means of a steel rod after having removed the opposite torsion bar.



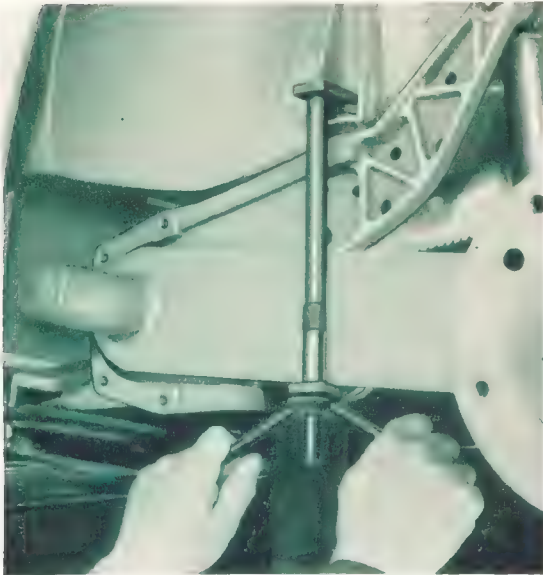
### Installation

This is a reversal of the preceding operations, but the following points should be observed:

- 7 - Withdraw spring plate and both rubber cushions.
- 8 - Remove about five of the foremost fender screws.
- 9 - Withdraw torsion bar from frame cross member and at the same time pull the fender aside to allow the torsion bar to clear it.
- 1 - Inspect torsion bar splined ends and paint for damage. Make sure there are no signs of rust, replace if necessary.
- 2 - Grease splines of torsion bar.
- 3 - Install torsion bar and spring plate and adjust them.
- 4 - Apply some graphite when installing rubber cushions.



- 5 - Hook the torsion bar tensioner (Drawing for Local Manufacture VW 655) to the rear cross tube flange and push the sliding part of the tensioner upward against the lower edge of the spring plate. By turning the nut, lift the spring plate until its lower edge is higher than the lower stop on the cross tube flange.



- 6 - Screw the spring plate installing tool (Drawing for Local Manufacture VW 656) to the cross tube flange in place of the spring plate hub cover. Place the thrust pad on the spring plate hub and press in the spring plate by tightening the thrust screw.



- 7 - Remove the tools and install the spring plate hub cover.

**Note:**

To facilitate the installation of the hub cover and to avoid damage to the threads, it is recommended to screw two tapered guide pins (approx. 45 mm/1.8" long) in two of the tapped holes, diagonally opposite. The cover is then pushed over the two guide pins, allowing two of the cover bolts to be screwed in. Afterward the two guide pins are removed and the two other bolts screwed in.

- 8 - Install torsion bar hub cap (where present) and secure it with a split pin.

- 9 - Clean mating faces between spring plate and axle bearing housing (traces of paint and rust). Tighten screws for axle bearing housing and shock absorber to a torque of 10—12 mkg (80—87 ft. lbs.).

**Note:**

Because of the modified torsion bar anchor in the frame, the splines at the anchor end of the torsion bars have been shortened from Chassis No. 1 600 440.

Torsion bars of new design (part No. 111 511 111 A) can be installed in frames of previous design. Torsion bars of previous design can also be installed in new frames.

After old stocks have been used up only torsion bars of new design will be available as spare parts.

## Shock Absorbers

Correctly operating rear shock absorbers are, beside a proper adjustment of the spring plates, of great importance to a perfect suspension and road-holding of the car. The shock absorber prevents the spring plate striking the lower stop at the cross member flange during rebound.

It is permissible to use shock absorbers of different manufactures on one rear axle, if they are similar in fundamental design, operation, and adjustment.

### Attention!

The telescopic shock absorbers for the Volkswagen or Transporter Front Axle should, on account of their different operating characteristics, never be fitted to the VW Rear Axle.

### Maintenance

The shock absorbers require no maintenance attention. If only a slight loss of fluid has taken place and the function of the shock absorber is still satisfactory, there is no need for an exchange, as an adequate fluid reservoir compensates smaller losses.

Worn parts of the shock absorber mounting are to be replaced after the shock absorber has been removed, using Repair Press VW 400 and the press tools VW 401, VW 410, VW 421, VW 436, VW 437 and VW 438.

### Inspection

As both the compression and rebound actions of the shock absorbers correspond to the springing characteristics of the car, no attempt should be made to disturb the adjustment or to fit shock absorbers of other characteristics. The riding qualities would otherwise be seriously affected. Shock absorber action may be roughly checked by bouncing each corner of the car in turn or by riding the car over a strongly uneven road. A more accurate check can be made by means of special testing appliances which are generally not available at the shop. A check by compressing the removed shock absorber by hand will only give an indication whether or not there is a resistance, the degree of efficiency of the compression and rebound strokes cannot be determined by this method.

## Removing and Installing Shock Absorbers

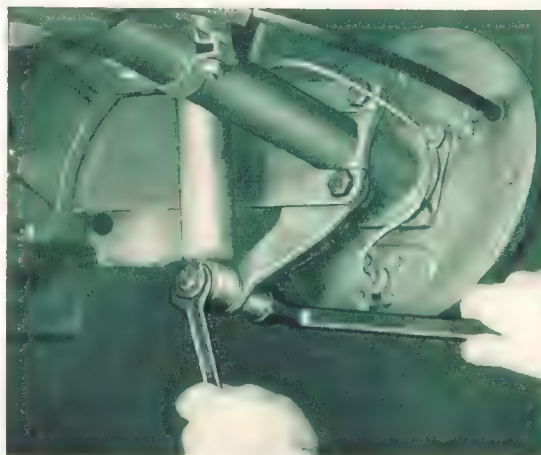
### Removal

- 1 - Lift the car.
- 2 - Remove cotter pins and nuts of mounting.
- 3 - Remove shock absorbers.

### Installation

Reverse the preceding operations and observe the following points:

- 1 - Test shock absorbers and, if necessary, replace.
- 2 - Inspect bushes and rubber bearings for wear.





# Description of Rear Axle

(Standard)

H

## General Description

Transmission, rear axle and engine are combined in the rear of the car. The rear axle is of the swing half axle type. The rubber-cushioned transmission case is secured to the frame at three points. It incorporates the transmission and the differential.

## Transmission Case

The bipartite transmission case is cast of light alloy. It must be clearly understood that when replacements are necessary it is not permissible to replace a single half of the transmission case. These are machined in pairs to very close limits and in consequence replacements must be made in pairs.

## Transmission

The transmission has four speeds forward and one reverse provided with a stop. The helical 3rd and 4th speed gears are in constant mesh and insure quiet operation.

Gear ratios:

1st	.....	3.60 : 1
2nd	.....	2.07 : 1
3rd	.....	1.25 : 1
top	.....	0.8 : 1
reverse	.....	6.6 : 1

## Gear Control

The shifting rod in the frame tunnel links the transmission to the gearshift lever which is located on the tunnel. 1st and 2nd speeds and reverse are brought into engagement by sliding gears. When shifting to 3rd or top speed, the nine pins bedded in the guide sleeve on the drive pinion engage with the holes provided in the gears.

## Final Drive

Power is transmitted through a helically-cut drive pinion and ring gear (crown wheel), provided with differential bevel gears, via two swinging axles to the rear wheels. Silent operation and a long service life of the final drive mechanism are only insured by carefully adjusting drive pinion and ring gear.

Gear ratios:

Klingelnberg toothing	.....	4.43 : 1
Gleason toothing	.....	4.37 : 1

The differential is to compensate the difference of wheel travel as the car makes a turn, thus maintaining an equal drive of the wheels.

## Rear Suspension

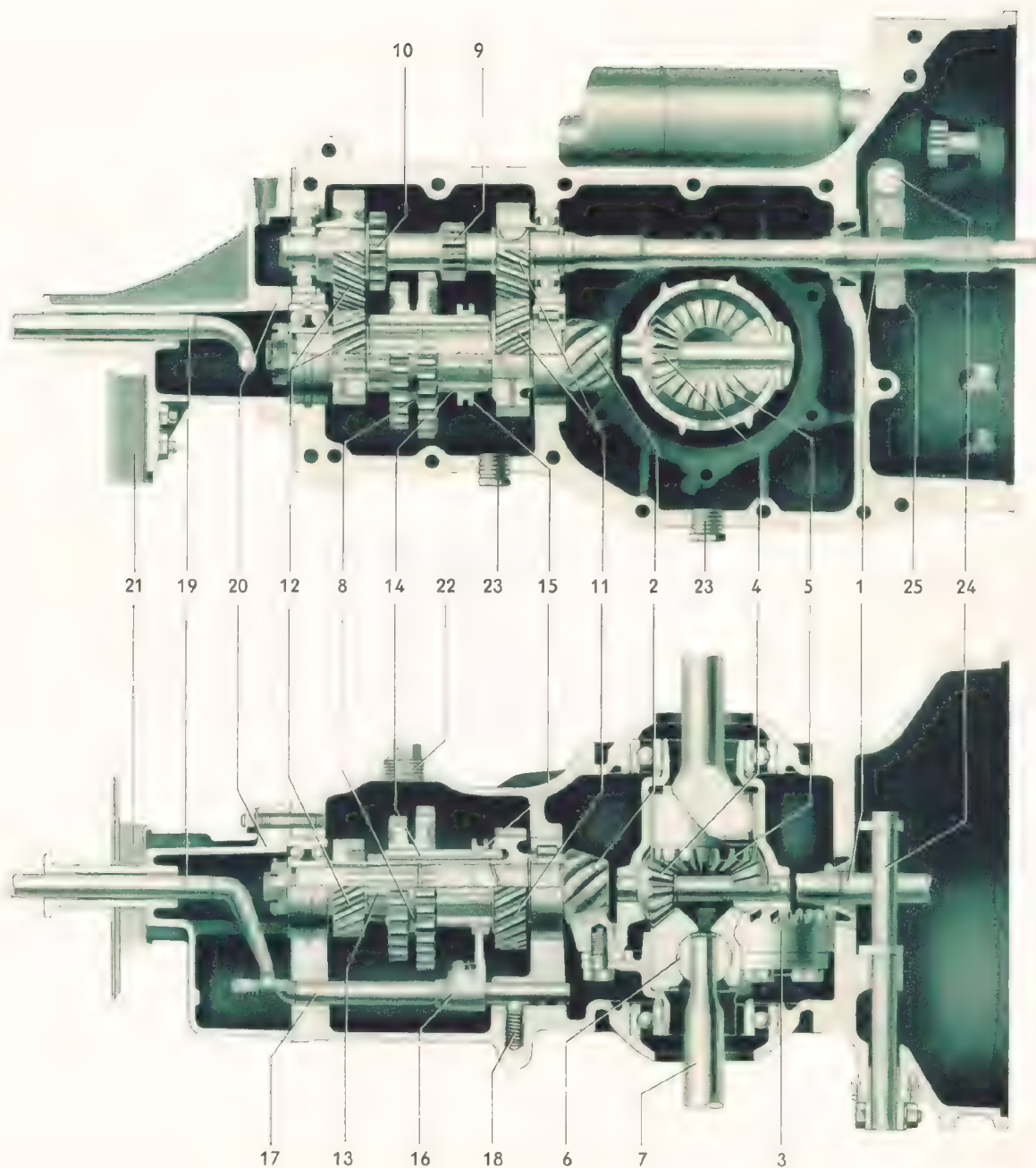
The rear wheels are sprung independently. Road shocks are transmitted to the left or right torsion bar by a spring plate on either side of the rear axle. The torsion bars are supported in the center of the cross tube and secured against twisting by a spline engagement.

An accurate adjustment of the rear wheel suspension is effected by means of the splines cut in both ends of each torsion bar in different numbers. Hydraulic double-acting shock absorbers of the telescopic design dampen road shocks and prevent excessive rebound.

## Oil Capacity

The oil capacity of the transmission case is 2.5 liters (5.3 U. S. pints; 4.4 Imp. pints). The oil should be changed at intervals indicated in the Lubrication Chart, using oil of the proper specification. When changing oil, the transmission case should be refilled with 2.0 liters (4.2 U. S. pints; 3.5 Imp. pints).





**Volkswagen — Rear Axle and Standard Transmission**  
(Sectional View)

- |                                    |                                     |                                      |
|------------------------------------|-------------------------------------|--------------------------------------|
| 1 - Main Drive Shaft               | 9 - 1st Speed Gear                  | 17 - Selector Shaft (Gearshift rail) |
| 2 - Drive Pinion                   | 10 - 2nd Speed Gear                 | 18 - Detent Spring and Ball          |
| 3 - Ring Gear (Crown wheel)        | 11 - 3rd Speed Gears                | 19 - Transmission Shift Rod          |
| 4 - Differential Pinion            | 12 - 4th Speed Gears                | 20 - Gearshift Housing               |
| 5 - Differential Side Gear         | 13 - Guide Sleeve                   | 21 - Rubber Cushion                  |
| 6 - Fulcrum Plate                  | 14 - Engaging Pin                   | 22 - Oil Filler Plug                 |
| 7 - Rear Axle Shaft                | 15 - Selector Ring (Gearshift ring) | 23 - Oil Drain Plug                  |
| 8 - 1st and 2nd Speed Sliding Gear | 16 - Selector Fork (Gearshift fork) | 24 - Clutch Operating Shaft          |

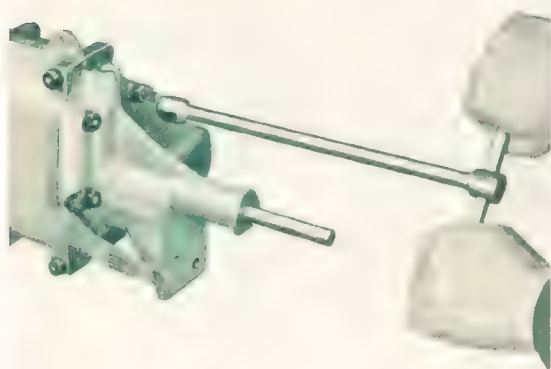
## Removing and Installing Gearshift Housing

### Removal

- 1 - Remove nuts that attach the rubber cushion to the gearshift housing.



- 2 - Remove gearshift housing nuts and take off ground copper braid.



- 3 - Take off gearshift housing and transmission shift lever.

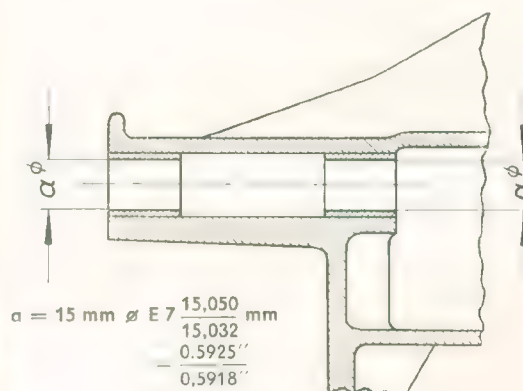
- 4 - Remove gasket and clean jointing faces.

### Installation

This is accomplished by reversing the removal procedure, but the following hints should be observed:

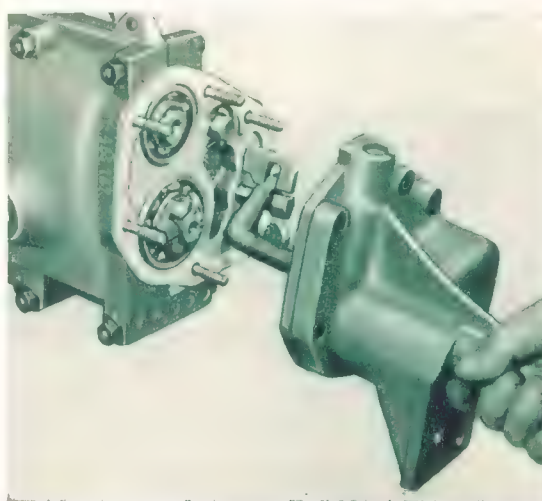
- 1 - Inspect transmission shift lever bushes. Worn bushes must be replaced by using the Repair Press VW 400 in conjunction with VW 401, 412,

and 439. The bushes are to be reamed up to

$$\frac{15.050}{15.032} \text{ mm} = \frac{0.5925''}{0.5918''}$$


- 2 - Note thicknesses of gasket and paper ring between gearshift housing and transmission case to insure that the ball bearings are correctly preloaded. Excessively preloaded ball bearings may cause noise and premature wear.

- 3 - Make sure the three selector shafts are in neutral position when attaching the gearshift housing.



- 4 - Connect ground copper braid to the correct stud.

## Preload on Transmission Ball Bearings

The assembly of the transmission case includes a careful consideration of the preload on the drive shaft double row bearing and the main drive shaft front bearing. The amount of preload should be determined prior to attaching the transmission case halves.

The gearshift housing is tightened in position to a preload of between 0.02 and 0.11 mm (0.0008" and 0.0043"). The preload is obtained by the correct selection of the gasket or the retaining ring at the main drive shaft front bearing.

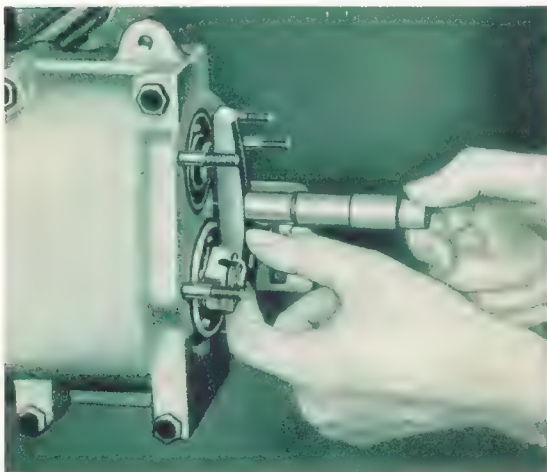
### How to Determine Preload

Before measuring, any end play of the drive pinion and main drive shaft should be eliminated by light taps with a mallet. The measuring should, if possible, be done with a depth micrometer.

The following dimensions should be checked:

a - Dimension D, distance from drive pinion bearing to matching face of transmission case.

Dimension C, depth of recess for drive pinion bearing. The difference between D and C is to be compensated by the selective fitting of the gasket to insure the prescribed preload (0.02—0.11 mm/0.0008"—0.0043") on the double row ball bearing.

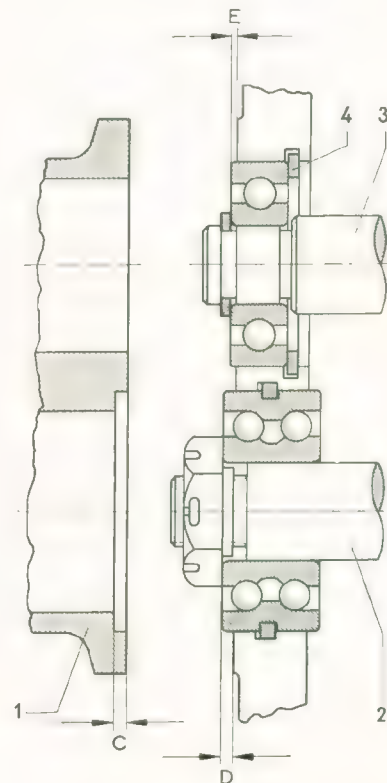


b - Dimension E, distance from main drive shaft bearing to matching face of transmission case.

This bearing must be subject to the same preload as the double row ball bearing. A selection of three thicknesses of retaining rings is available to correct the preload on the main drive shaft bearing.

Thicknesses of retaining ring:

2.0—2.1—2.2 mm (0.079"—0.083"—0.087").



- 1 - Gearshift housing
- 2 - Drive pinion
- 3 - Main drive shaft
- 4 - Retaining ring

C - Depth of recess for double row ball bearing in gearshift housing.

D - Distance from double row ball bearing to transmission case matching face.

E - Distance from main drive shaft ball bearing to transmission case matching face.



## Example:

a - Dimension D .....	3.60 mm
Dimension C .....	3.30 mm
Difference .....	0.30 mm
Dimension for preload .....	— 0.10 mm
Thickness of gasket .....	0.20 mm

b - Dimension E .....	0.20 mm
Thickness of gasket .....	— 0.20 mm
Preload on main drive shaft ball bearing .....	0 mm

To obtain the required preload, the thickness of the ball bearing retaining ring must be increased by 0.1 mm.

## Disassembly and Assembly of Transmission Case

The two transmission case halves are machined in pairs to very close limits and in consequence replacements must be made in pairs. It is not necessary to replace the gearshift housing together with the transmission case. After the matching faces have been cleaned, they must be lightly coated with sealing compound. A replacement of the transmission case necessitates a readjustment of the preload on the differential ball bearings by a selective fitting of shims.

**Note.** — The Rear Axle Number is stamped on the right transmission case half at the gearshift housing jointing flange.

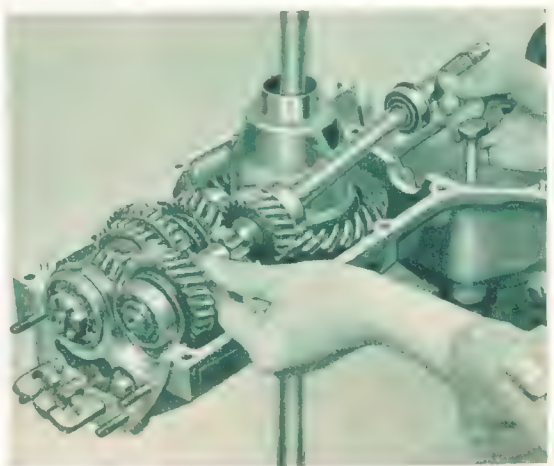
### Disassembly

- 1 - Remove gearshift housing.
- 2 - Remove clutch release bearing and disconnect clutch operating lever return spring.
- 3 - Remove screws at transmission case matching faces and clutch cable supporting bracket.

- 4 - Turn the transmission case and take off right transmission case half.

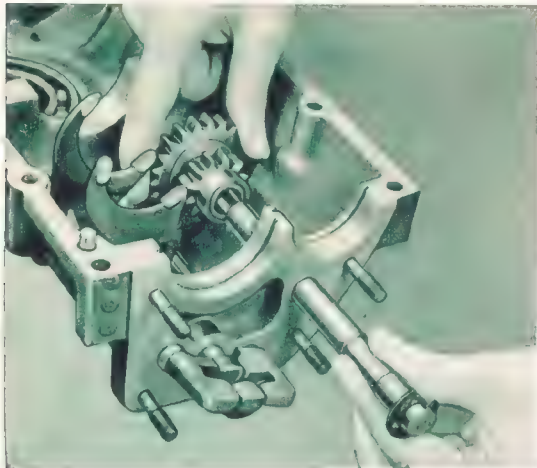


- 5 - Lift complete main drive shaft and drive pinion from left transmission case half.

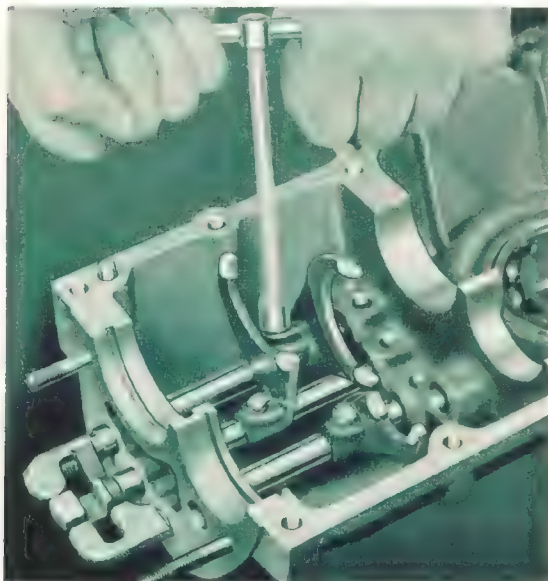


6 - Drive out differential and rear axle shafts from the left transmission case half by means of a mallet. Note arrangement of the differential shims to assure proper installation at assembly.

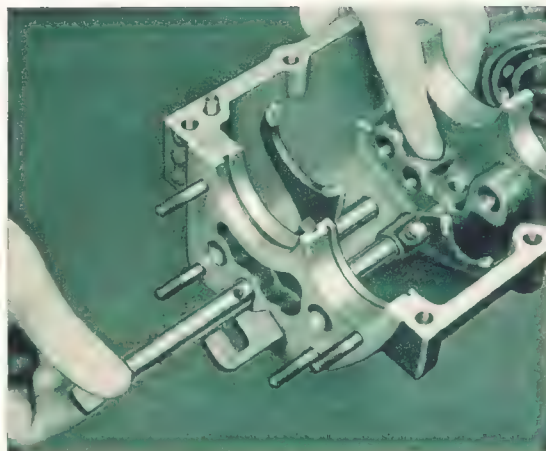
7 - Remove reverse sliding gear shaft and reverse sliding gear.



8 - Remove selector fork screws with Wrench VW 114 after having removed the locking wire. Withdraw selector shafts and prevent detent



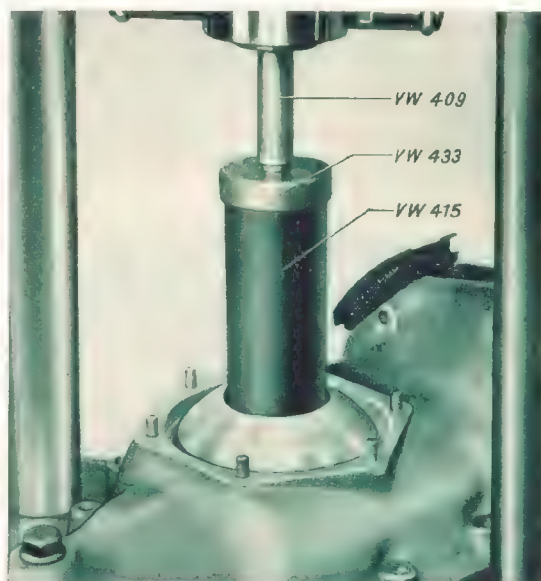
balls to jump off by covering the holes. Lift out selector forks.



9 - Remove detent balls and springs.

10 - Take out the two selector shaft interlock plungers.

11 - Remove the differential ball bearings, using extractor VW 290 b or Repair Press VW 400 in conjunction with VW 409, VW 415, and VW 433.



12 - Remove clutch operating shaft and lever, return spring and return spring seat.



### Assembly

This is effected by reversing the preceding operations, but the following points should be noted:

- 1 - Thoroughly clean transmission case and check it for wear, external damage and cracks; replace it if necessary.

In the case of the drive pinion or ring gear (crown wheel) being damaged (e. g., breakage), check the bores in the transmission case webs for alignment; replace transmission case if necessary.

- 2 - Check starter shaft bush for wear, using plug gauge VW 246. If necessary, replace the bush by means of drift VW 222 or Repair Press VW 400 in conjunction with VW 401, VW 408 and VW 438.



**Note.** — Replacement of starter shaft bush with engine in situ:

Removal with extractor ..... VW 228  
Installation with drift ..... VW 222

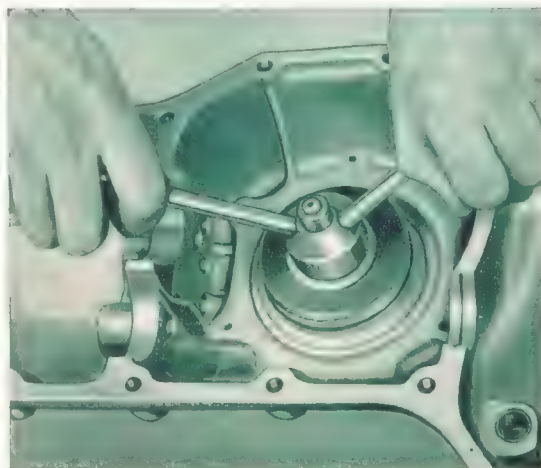


- 3 - Check clutch operating shaft bushes for wear, replace as necessary.

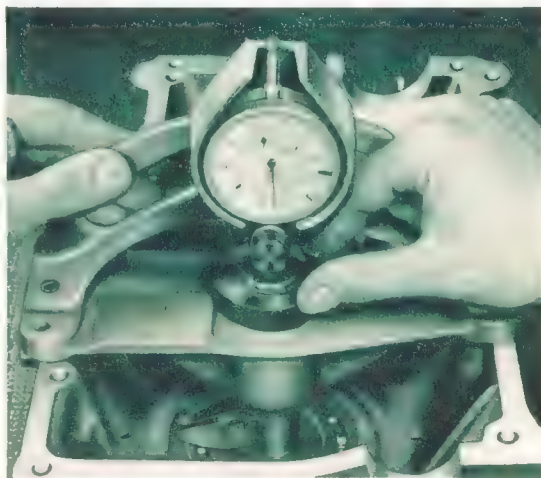
#### Important!

The clutch operating shaft must in all cases be installed before the transmission case halves are screwed together.

- 4 - Press the differential ball bearings in place, using Special Tool VW 290a or Repair Press VW 400 in conjunction with VW 401, VW 409, VW 415 and VW 433.

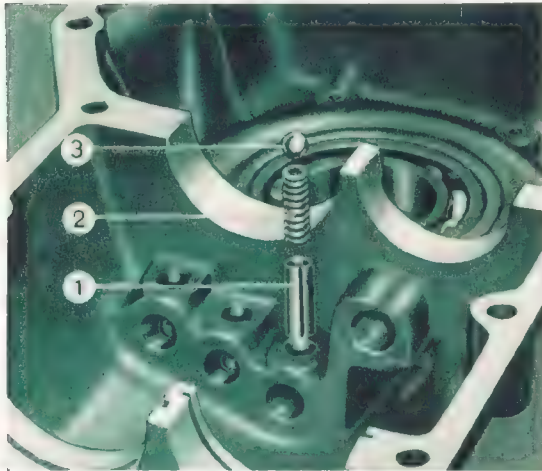


Check square seating of ball bearings by means of gauge VW 285, the permissible tilt being 0.02—0.04 mm (0.0008"—0.0016").





- 5 - Examine detent springs and replace as necessary. Free length of detent spring: 25 mm (1''); wear limit: 23 mm (0.9''). The force applied to overcome the detent ball undercuts on the selector shafts should amount to approx. 20 kg (45 lbs.).

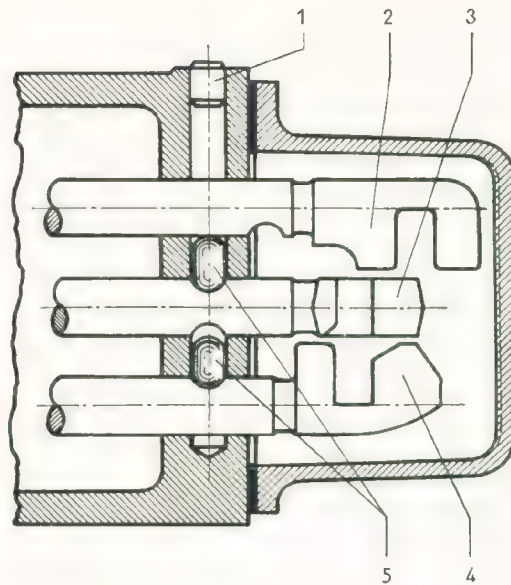


1 - Guide sleeve 2 - Detent spring 3 - Detent ball

- 6 - Install selector shafts in the order 3rd/4th gears, 1st/2nd gears and reverse, taking care not to omit the two interlock plungers. Check for

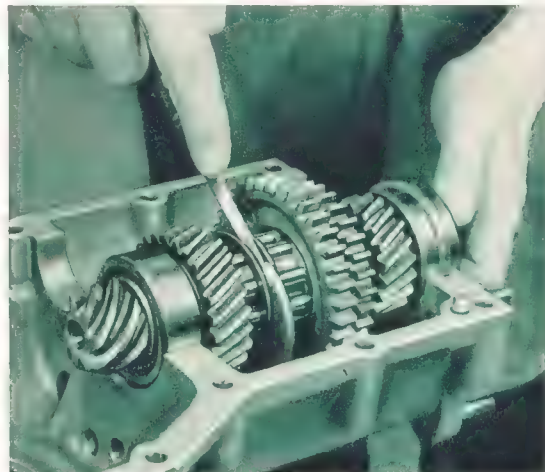


proper interlocking by engaging a gear. The selector shaft next to the one used must be locked. When engaging 1st or 2nd gears (center selector shaft), the two other selector shafts should be locked.



1 - Plug for interlock plunger channel  
2 - Selector shaft for reverse  
3 - Selector shaft for 1st and 2nd gears  
4 - Selector shaft for 3rd and 4th gears  
5 - Interlock plungers

- 7 - Check selector forks for wear. The clearance between selector forks and selector ring should not be in excess of 0.53 mm (0.021''). Replace worn parts.



- 8 - Tighten selector fork screws, making sure that they properly fit in the corresponding recesses provided in the selector shafts and the secure them by means of wire.

- 9 - Examine reverse sliding gear bush and reverse sliding gear shaft; if necessary, replace as follows:

Press out the bush on Repair Press VW 400 in conjunction with VW 401, VW 409 and VW 420 and install it in conjunction with VW 401, VW 412 and VW 420. Peen the bush securely in position and ream it up to

$$\frac{16.093}{16.050} \text{ mm diam.} = \frac{0.6336''}{0.6319''}$$

- 10 - Inspect differential and replace worn or damaged components.

Be sure that the differential shims occupy their original positions.

**Attention!**

VW Passenger Cars: Ring gear (crown wheel) is in left transmission case half  
VW Transporter: Ring gear (crown wheel) is in right transmission case half

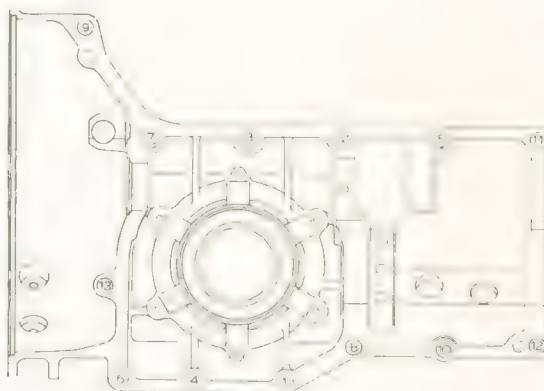
- 11 - Inspect drive pinion, main drive shaft, and oil seal; replace worn or damaged parts. Oil the contact surface of the oil seal lip before sliding the oil seal on the main drive shaft.

Care must be taken to see that the ball bearing retaining ring is bedding correctly in the provided ring groove.

- 12 - Before attaching the transmission case halves, check the gearshifting and proper meshing of all gears.

- 13 - Clean all jointing faces and oil seal seatings and lightly coat them with Sealing Compound D 1 a prior to assembly.

- 14 - Tighten transmission case screws in the below indicated order to a torque of 2 mkg (15 ft. lbs.).



- 15 - Connect clutch operating lever return spring after the clutch release bearing has been fitted.

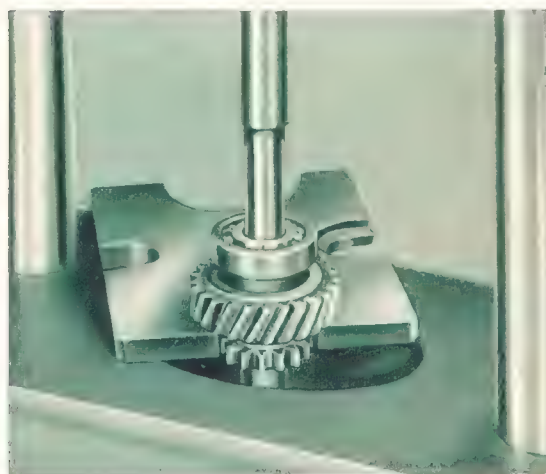
## Reconditioning Main Drive Shaft

### Disassembly

- 1 - Disassemble transmission case and lift out main drive shaft.
- 2 - Remove ball bearing retaining ring at third speed gear, using tool VW 161 a.



- 3 - Remove ball bearing retaining ring at fourth speed gear.
- 4 - Remove fourth speed gear, retaining ring and ball bearing by means of the Repair Press VW 400 in conjunction with VW 401 and VW 408.



- 5 - Remove third speed gear and ball bearing by means of the Repair Press VW 400 in conjunction with VW 401 and VW 412.

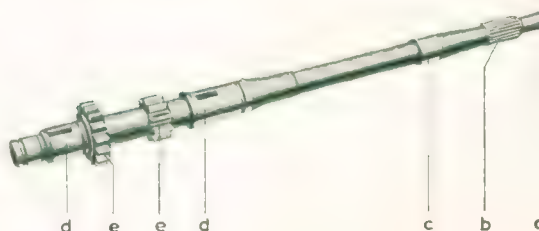
- 6 - Take off the keys in the main drive shaft.

- 7 - Clean the main drive shaft, especially its center holes.

### Inspection

- 1 - Check main drive shaft for wear:

- a - Check pilot for flywheel gland nut bush for wear.
- b - Check splines for wear (radial clearance).
- c - Check oil seal seating for scores and signs of wear.
- d - Make sure that the ball bearings and gears (3rd and 4th speeds) are a press fit on their seats.
- e - Check first and second speed gears for wear and damage.

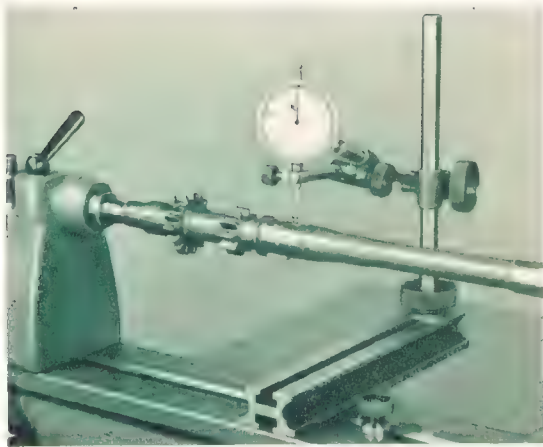


- a - Pilot
- b - Splines
- c - Oil seal seat
- d - Seat (3rd and 4th gears)
- e - Gears for 1st and 2nd speeds

Excessive wear, damage or excessive play necessitate a replacement of the main drive shaft. If the gears for the 1st and 2nd speeds are found to be excessively worn, the corresponding sliding gear on the drive pinion should also be checked and, if necessary, replaced.

- 2 - Check main drive shaft for run-out. Place main drive shaft between two points and check at intermediate seat. Permissible run-out: max. 0.05 mm (0.002"). If the run-out is in excess of this limit, the main shaft may be straightened in cold condition.





**Note.** — With the main drive shaft installed in the transmission case, the run-out (max. 0.2 mm/0.008") should be measured at the pilot.

3 - Inspect ball bearings for wear and damage, replace as necessary.

4 - Check third and fourth speed gears for wear and damage, replace as necessary.

**Attention!**

The gears for the third and fourth speeds must only be replaced in pairs.

**Assembly**

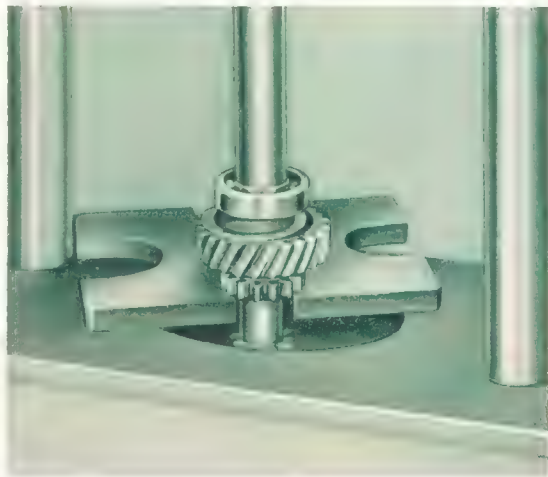
This is effected by reversing the disassembly procedure, but the following points should be observed:

1 - Place the two keys in position.

**Important!**

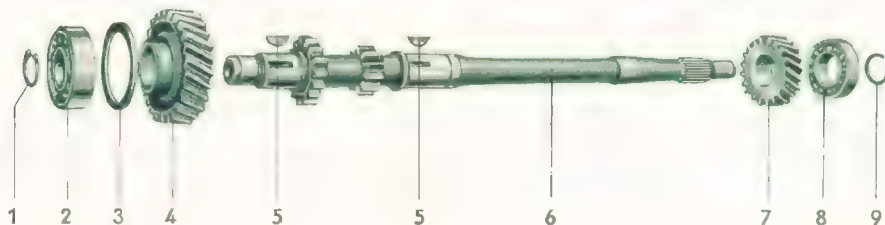
Before pressing the gears and ball bearings in place, they must be heated to approx. 80° C (180 °F) in an oil bath. Gears and ball bearings must be a press fit on the main shaft.

2 - Press fourth speed gear and then the ball bearing in place, using Repair Press VW 400 in conjunction with VW 401, VW 412 and VW 420. Do not forget to refit the ball bearing retaining ring.



3 - Press third speed gear and then the ball bearing in place, using Repair Press VW 400 in conjunction with VW 401, VW 412 and VW 419.

4 - Install retaining rings for the ball bearings.

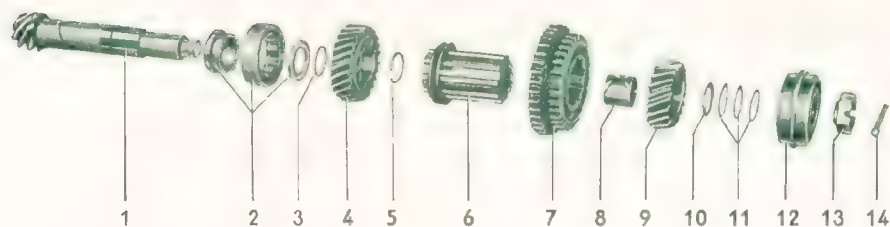


1 - Retaining ring  
2 - Ball bearing  
3 - Retaining ring

4 - 4th speed gear  
5 - Keys  
6 - Main drive shaft

7 - 3rd speed gear  
8 - Ball bearing  
9 - Retaining ring

## Reconditioning Drive Pinion



1 - Drive pinion  
2 - Roller bearing  
3 - Retaining ring  
4 - 3rd speed gear  
5 - Retaining ring

6 - Guide sleeve with  
engaging pins and  
selector ring  
7 - Sliding gear for 1st  
and 2nd speeds  
8 - Bush  
9 - 4th speed gear

10 - Spacer  
11 - Shims  
12 - Double row ball bear-  
ing with retaining ring  
13 - Nut  
14 - Cotter pin

### Disassembly

- 1 - Open transmission case and lift out drive pinion.
- 2 - Place drive pinion in holding fixture VW 314.
- 3 - Remove cotter pin and screw off the nut.

5 - Take off spacer and shims.

6 - Take off fourth speed gear and bush.

7 - Remove sliding gear for first and second speeds.

8 - Remove guide sleeve, engaging pins, and selector ring.

9 - Remove guide sleeve retaining ring.

10 - Take off third speed gear.

11 - Remove roller bearing retaining ring, using tool VW 161 a.

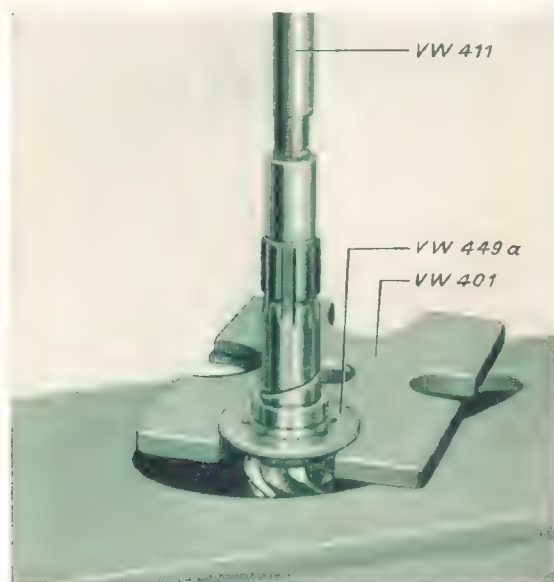


- 4 - Remove double row bearing on Repair Press VW 400 in conjunction with VW 402 and VW 408.



## 12 - Extract roller bearing

- a - Klingelnberg toothing (7 teeth). Use Repair Press VW 400 in conjunction with VW 401, 411, and 449a.



- b - Gleason toothing (8 teeth). Use Repair Press VW 400 in conjunction with VW 401, 411, and 449b.

- 13 - Clean drive pinion. The oil passages must be free and unobstructed. Compressed air should be used to blow them out.

## Inspection

- 1 - Inspect drive pinion for wear and damage, if necessary replace drive pinion and ring gear as a pair. (Note matching number).
- 2 - Check condition of roller bearing and double row ball bearing; replace if necessary.
- 3 - Check gears for 3rd and 4th speeds for wear and damage; replace as necessary, but only in pairs.
- 4 - Check guide sleeve, selector ring, and engaging pins for wear and damage and renew as necessary. The engaging pins should have no undue radial clearance in the grooves of the guide sleeve to obviate a slipping out of the gears.
- 5 - Examine sliding gear for 1st and 2nd speeds for wear and damage; replace if necessary. If excessive wear or damage is found, also check gears on main drive shaft. Replace the main drive shaft, should it be necessary.

- 6 - Check 4th gear bush, spacer, and shims for wear and replace as necessary.

## Assembly

This is a reversal of the disassembly procedure, but the following points should be observed:

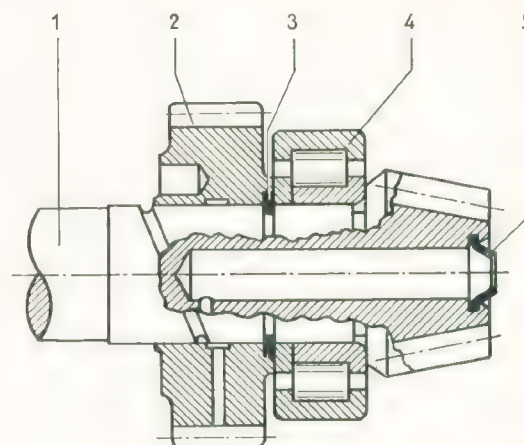
- 1 - The roller bearing inner race should be heated in an oil bath to 90 °C (194 °F) before pressing it in position.

### Important!

Be sure the roller bearing is a press fit on the drive pinion. A loose fit necessitates a replacement of the worn parts.

Fit roller bearing with friction washer toward third speed gear. Install roller bearing locking.

Guide the retaining ring with one hand while expanding it with the pliers to allow it to be slipped in position. Do not overstrain the ring. Check if the ring is correctly bedding at the bottom of the ring groove. Replace ring if overstrained.



- 1 - Drive pinion
- 2 - Gear for 3rd speed
- 3 - Retaining ring
- 4 - Roller bearing
- 5 - Oil baffle disc

- 2 - Install 3rd speed gear.

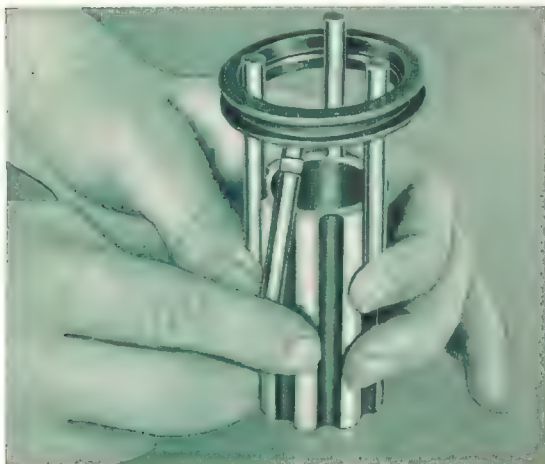
- 3 - Install guide sleeve retaining ring.



**Note:**

Under certain circumstances it is possible that the required 3rd speed gear end play cannot be obtained. To reach the correct end play when assembling the drive pinion, a guide sleeve retaining ring of 2.4 mm (0.09") thickness has been introduced in addition to the retaining ring of 2 mm (0.08") dia. The new retaining ring can be recognized by the flat faces, whereas the earlier ring has a round cross section. When the drive pinion is assembled, the roller bearing and the 4th speed gear are to be pushed simultaneously towards the 3rd gear. If the end play at the 3rd gear is below the low limit, the guide sleeve retaining ring of 2 mm (0.08") thickness should be replaced by the thicker ring (2.4 mm/0.09").

- 4 - Assemble guide sleeve, engaging pins, and selector ring. Hold guide sleeve in one hand so that the internal splines are at the bottom. Fit three engaging pins to the guide sleeve at an equal distance from one another and slide selector ring over them so that the internal shoulder faces downward. Fit the six remaining pins.

**Note:**

From Chassis No. 1167145 shifting pins that are eccentric at the ends engaging the 4th gear are being used on all standard transmissions.

**Attention!**

The new pins can be incorporated in earlier transmissions as and when the opportunity offers; they constitute a greater protection against a slipping out of the 4th gear.

- 5 - Slide guide sleeve on the drive pinion taking care that the plain portion of the guide sleeve hole is at the front.

- 6 - Place sliding gear for 1st and 2nd speeds on drive pinion so that the larger diameter is toward the selector ring.

- 7 - Install 4th speed gear and bush.

- 8 - The radial play and the end play of the 4th speed gear should, if possible, be at the lower tolerance limit:

Lower limit of radial play 0.04 mm/0.0016".

Lower limit of end play 0.25 mm/0.0098".

- 9 - Install shims on drive pinion as required to obtain the correct axial adjustment. Shims in the thicknesses 0.2 mm and 0.3 mm (0.008" and 0.012") are available for this purpose so that the axial adjustment can be corrected in units of 0.1 of a millimeter.

- a - When replacing parts of the drive pinion assembly which do not affect the axial adjustment, the total thickness of the shims should not be altered to insure a correct meshing of pinion and ring gear.

- b - When replacing drive pinion or other parts which affect the axial adjustment, the proper amount of shims must be determined once more.

The standard thickness of the total shims is 0.7 mm (0.275"). The plus or minus marking on the drive pinion face must be considered in this connection.

**Example:**

Standard thickness of shims .... 0.7 mm

Axial tolerance discrepancy

—0.18 mm. This value is to be raised to the next tenth of a millimeter, namely .....

Total thickness of shims required — 0.2 mm 0.5 mm

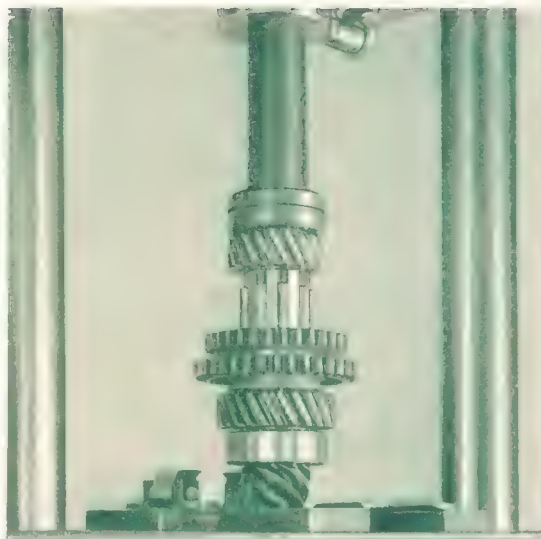
The total thickness of shims should be checked by the test mandrel VW 289 and an impression of the drive pinion tooth bearing when positioning drive pinion and ring gear.

10 - Press double row ball bearing in position, using Repair Press VW 400 in conjunction with VW 402 and VW 416. The channel machined in the outer race of the bearing for fitting the balls must face the drive pinion nut.

11 - Tighten drive pinion nut with torque wrench VW 118/30 and socket VW 162 as detailed below:

First tighten nut to a torque of 15 mkg (108 ft. lbs.) and loosen it again. Then tighten to a torque of between 6 and 7 mkg (45 and 50 ft. lbs.) and continue to turn the nut until the next slot is in line with one of the two holes for the cotter pin.

12 - Fit cotter pin not before the axial adjustment of the pinion has been rechecked.



The section "Rear Axle and Synchromesh Transmission" contains instructions on:

Removing and Installing Rear Axle

Disassembly and Assembly of Rear Axle

Rear Wheel Bearing Seat and Axle Tubes

Final Drive

Gear Control

Rear Suspension



# Tools and Appliances

# H

## 1 - VW Special Service Tools

VW 112	Special Wrench 36 mm with Guide Plate
VW 114	T-Wrench 8 mm Square Socket
VW 161 a	Circlip Pliers
VW 163 a	36 mm Socket
VW 202	Extractor
VW 202 b	Extractor Hooks
VW 202 h	Distance Sleeve
VW 222	Starter Shaft Bush Pilot Drift
VW 228 a	Starter Shaft Bush Extractor
VW 230	Rear Axle Shaft Oil Seal Installing Tool
VW 240 a	Driver
VW 241 a	Ball Bearing Extractor
VW 245 a	Protactor
VW 246	Not-Go Plug Gage
VW 285	Differential Ball Bearing Gage (Required by large workshops and for unit reconditioning only)
VW 287	Differential Housing Gage
VW 288 b	Backlash Gage
VW 289 b	Transmission Case Mandrel
VW 290 a	Ball Bearing Installing Tool
VW 290 b	Ball Bearing Removing Tool
VW 291 b	Main Drive Shaft Oil Seal Installing Tool
VW 307	Fixture
VW 308	Stand
VW 314	Fixture
VW 400	Repair Press 15 t
VW 401	Thrust Plate
VW 402	Thrust Plate
VW 405	Punch with V-Block
VW 406	V-Blocks (two)
VW 407	Punch
VW 408	Punch
VW 409	Punch
VW 410	Punch
VW 411	Punch
VW 412	Thrust Disc
VW 415	Tube, 75 mm dia.
VW 416	Tube, 38 mm dia.
VW 419	Tube, 32 mm dia.
VW 420	Tube, 28 mm dia.
VW 421	Tube, 28 mm dia.
VW 430	Thrust Pad (Bronze)
VW 431	Thrust Pad, 16.5/28 mm dia.
VW 433	Thrust Pad
VW 436	Guide Pin (Tapered)
VW 437	Guide Pin (Tapered)
VW 438	Guide Pin (Cylindrical)
VW 439	Guide Pin (Shouldered)
VW 442	Thrust Pad
VW 449 a	Toothed Thrust Ring
VW 449 b	Toothed Thrust Ring

## 2 - VW Workshop Equipment for Local Manufacture

VW 605	Gantry Crane
VW 633	Trestle
VW 655	Torsion Bar Tensioner
VW 656	Spring Plate Installing Tool
VW 664	Differential Housing Holding Fixture



### 3 - Normal Hand Tools

Combination pliers  
Cold Chisel  
Prick punch (center punch)  
Pin punch, 4 mm  
Mechanic's hammer, 300 grams  
Mechanic's hammer, 500 grams  
Rubber mallet, 85 x 50 mm  
Triangular scraper  
Flat scraper  
Flat file, 180 mm in length  
Half-round file, 180 mm in length  
Socket wrench, 11 mm  
Socket wrench, 12 mm  
Socket wrench, 13 mm  
Socket wrench, 14 mm  
Socket wrench, 15 mm  
Socket wrench, 17 mm  
Socket wrench, 19 mm  
Open-end wrench, 14 mm  
Open-end wrench, 17 mm  
Open-end wrench, 19 mm  
Box wrench, 14 mm  
Box wrench, 15 mm  
Box wrench, 17 mm  
Box wrench, 19 mm  
Box wrench, 27 mm  
Wire brush  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl  
Dial indicator  
Set of feeler gages, 0.1—0.5 mm  
Micrometer Caliper, 0—25 mm  
Micrometer Caliper, 25—50 mm  
Micrometer Caliper, 50—75 mm  
Caliper square, 300 mm in length, measuring 1/50 mm  
Depth gage, 300 mm in length, measuring 1/50 mm  
Straight edge, 1000 mm in length  
Dial gage for checking 18—100 mm inside diameters, measuring 1/1000 mm  
Tap M 6  
Tap M 8  
Tap M 10  
Tap M 12 x 1.5  
Die stock, size 1  
Die Stock, size 2  
Die M 6  
Die M 8  
Die M 10  
Die M 12 x 1.5  
Tap wrench, size 1, adjustable  
Tap wrench, size 2, adjustable  
Torque wrench, 0—30 mkg (217 ft. lbs.)  
Inspection lamp with cable and plug  
Electric drill  
Oil funnel

### 4 - Supplementary Workshop Equipment

Run-out testing device  
Track (tread) gage  
Wheel alignment service equipment



## Contents:

### Hydraulic Brake

- 1 - Description
- 2 - Master Cylinder
- 3 - Wheel Cylinder
- 4 - Hydraulic Lines
- 5 - Wheel Brake
- 6 - Filling, Bleeding and Adjustment of Brake
- 7 - Special Hints

### Mechanical Brake

- 8 - Description
- 9 - Brake Control
- 10 - Wheel Brake
- 11 - Brake Adjustment
- 12 - Special Hints

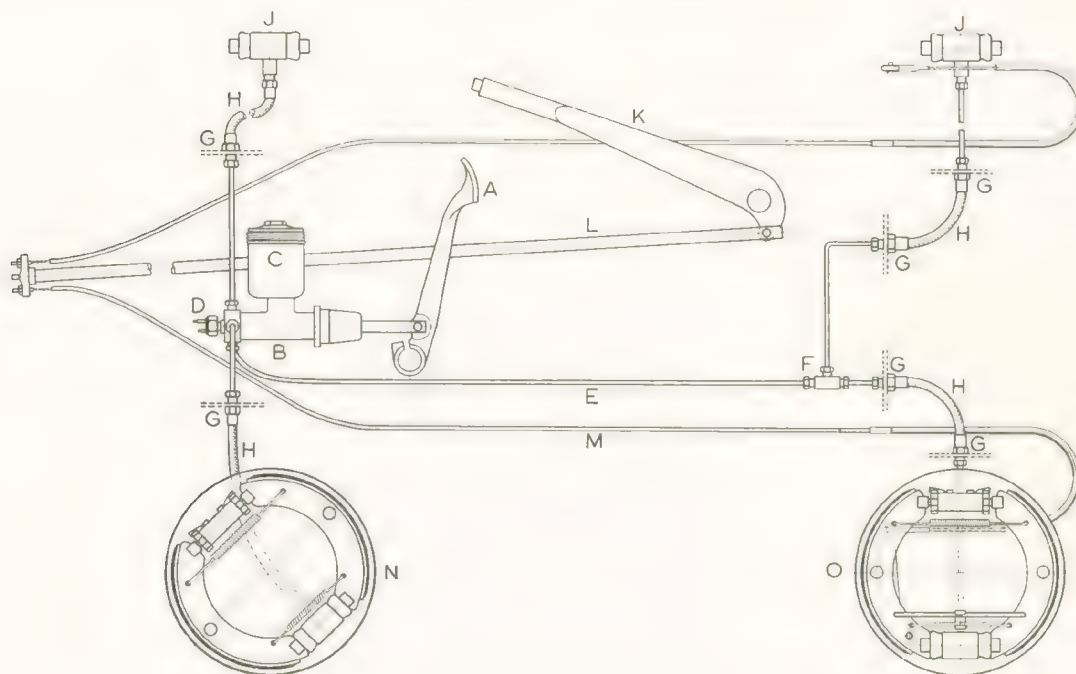
### Wheels and Tires

- 13 - Wheels
- 14 - Tires
- 15 - Special Hints

- 16 - Tools and Appliances

The function of the hydraulic brake is based on Pascal's law:

"Pressure applied to a given area of a fluid enclosed in a vessel is transmitted undiminished to every equal area of the vessel".



Diagrammatic view of complete hydraulic brake system

- |                          |                        |
|--------------------------|------------------------|
| A - Brake pedal          | H - Brake hose         |
| B - Master cylinder      | J - Wheel cylinder     |
| C - Fluid reservoir      | K - Hand brake lever   |
| D - Stop light switch    | L - Brake push bar     |
| E - Hydraulic line       | M - Cable conduit tube |
| F - Three-way connection | N - Front wheel brake  |
| G - Brake hose bracket   | O - Rear wheel brake   |

The brake system consists of:

**Master cylinder**, in which the hydraulic pressure is generated;

**Fluid reservoir**, maintaining the constant volume of the brake fluid;

**Wheel cylinder**, forcing the brake shoes against the drum;

**Hydraulic lines**, connecting master cylinder to wheel cylinders, hoses being used at moving parts.

The master cylinder is provided with one piston and each wheel cylinder with two pistons. Rubber boots prevent leakage.



## Operation

When the brake pedal is depressed, the piston is forced into the master cylinder, generating high pressure. This pressure is transmitted with equal and undiminished force to the four wheel cylinders.

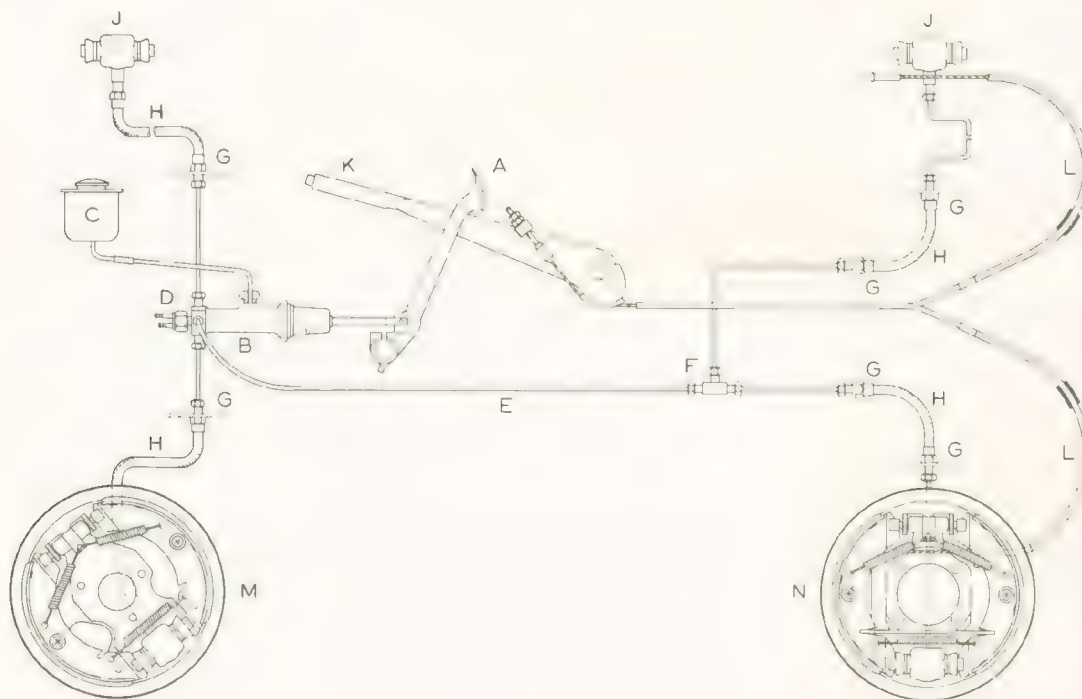
The fluid pressure forces the two pistons in each wheel cylinder outward, expanding the brake shoes against the drums.

The amount of pressure applied on the brake pedal determines the amount of braking action that takes place between the brake shoes and the drums.

When the brake pedal is released, master cylinder piston, wheel cylinder pistons and brake shoes return to their released positions by means of their respective return springs.

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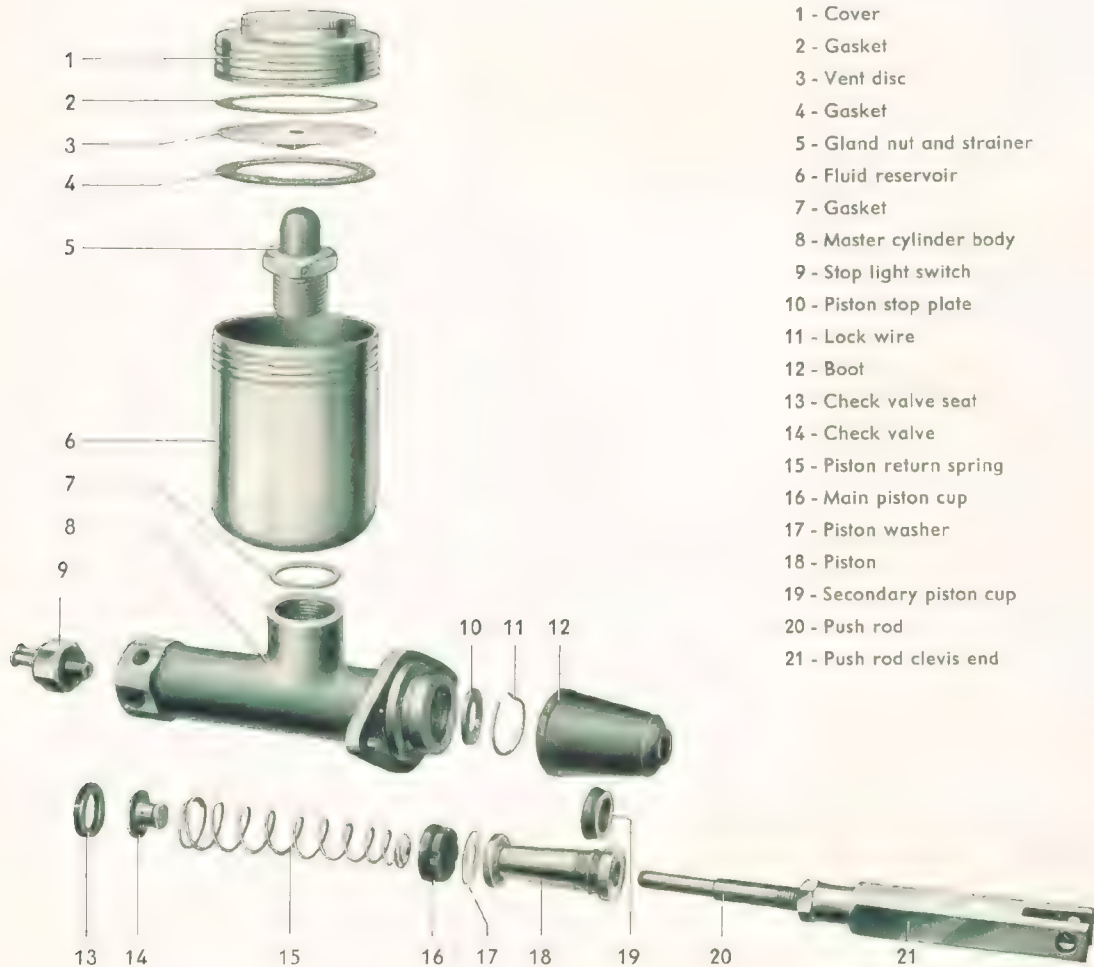
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## Hand Brake

The mechanical hand brake is operated by pulling up the horizontally placed hand brake lever, which is of the ratchet-and-pawl type. Both cables are anchored direct to the lever and are guided in tubes to the rear wheels.



The push rod links the piston in the master cylinder to the brake pedal. When depressing the brake pedal, the piston forces the hydraulic fluid through the brake lines into the wheel cylinders.



## Fluid Reservoir

Make sure the vent hole in the cover is clear of obstruction to prevent a vacuum or pressure from forming in the fluid reservoir (be careful when painting!).

When filling the reservoir, it should be made sure that the cover is absolutely clean so as to avoid getting any dirt into the hydraulic system. The reservoir should be sufficiently filled, that is, up to 15—20 mm (0.6''—0.8'') below the upper edge.

**Important!**

Never use mineral oil, but only VW Genuine Brake Fluid or Lockheed Brake Fluid.  
Never allow the brake fluid to come into contact with painted parts.

**Brake Fluid Compensation**

Temperature changes cause contraction or expansion on the liquid in the cylinders and the lines. Directly in front of the main rubber cup is a by-pass port which insures that the system is maintained full of fluid at all times, and allows full compensation for expansion or contraction. If the by-pass port is choked by foreign matter or covered by the main rubber cup, as a result of incorrect pedal adjustment, pressure will build up in the system and all brakes will drag.

**Important!**

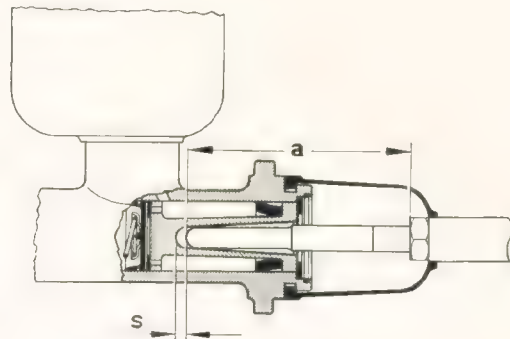
The by-pass port must be free when the system is at rest.

The piston push rod at the brake pedal must be carefully adjusted so as to make sure that there is a free movement (S) of approx. 1 mm (0.04'') between the push rod and the piston. The by-pass port will otherwise not be clear of the main rubber cup.

The required play is obtained by adjusting the piston push rod to the length  $a = 53\text{—}52\text{ mm}$  (2.09''—2.05'') and by shifting the pedal stop plate.

$$S = 1\text{ mm (0.04'')}$$

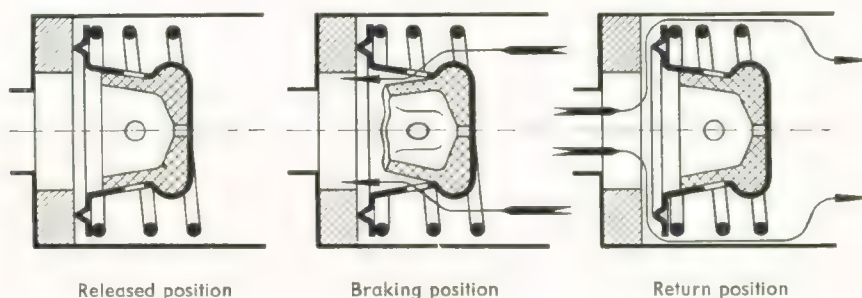
$$a = 53\text{—}52\text{ mm (2.09''—2.05'')}$$



### Check Valve

The check valve consists of a perforated metal body to which is attached a rubber valve seat. Inside the valve body is a small rubber cup which seals the perforations. The function of the valve is to prevent fluid from returning to the master cylinder during bleeding, thus ensuring a charge of fresh fluid being delivered at each stroke of the foot pedal. During normal operation, the action of the valve is as follows: —

When depressing the brake pedal, the piston forces fluid through the perforations in the valve bodies, causing the internal cup to collapse and create a free passage. When releasing the pedal, the action of the brake shoe return springs causes the fluid delivered to the wheel cylinders to be returned to its original position in the system, and the returning fluid lifts the complete valve assembly to allow free passage, until the pressure it exerts is overcome by the piston return spring, when the valve closes.



### Piston Cups

Additional fluid is drawn into the pressure chamber of the cylinder from the annular space formed by the piston skirt through the small holes in the piston head, via the main cup, as a result of the vacuum created by the rapid return of the piston after each brake application. This prevents air to be drawn into the system. As the system comes to rest, due to the action of the brake shoe return springs, the excess fluid passes to the fluid reservoir via the by-pass port.

The outer end of the annular space around the piston is sealed by the secondary cup. The co-ordinated function of by-pass port, check valve, and main cup allows the system to compensate for any changes and prevents any ingress of air.

Assembled master or wheel cylinders should, if possible, be no longer stored than three months. If circumstances necessitate the cylinders to be stored over a longer period, they should be inspected regularly.

**Important!** Note when replacing a master cylinder: —

Master cylinder up to Chassis No. 167,889	22.2 mm diam.
Master cylinder from Chassis No. 167,890	19.05 mm diam.

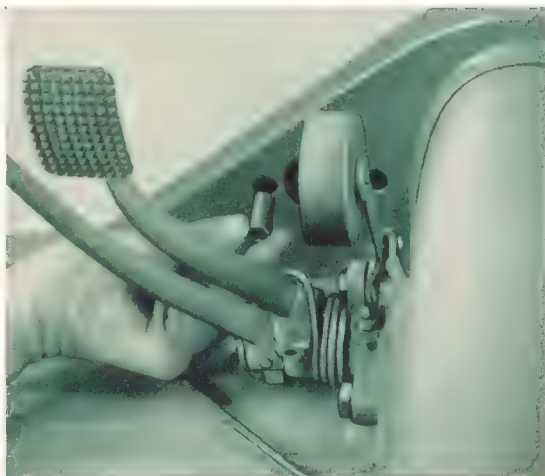
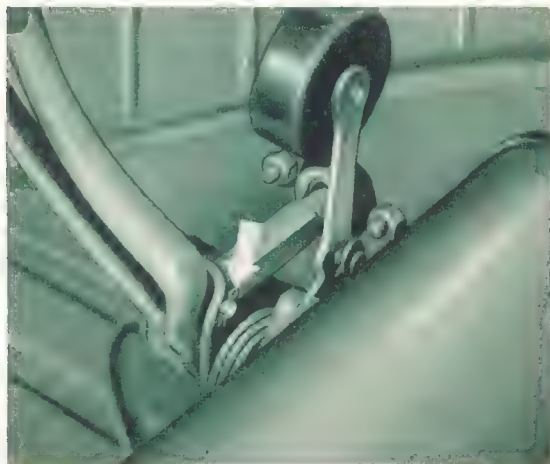


## Master Cylinder Removal and Installation

The master cylinder is to be removed for cleaning and inspecting its components.

### Removal

- 1 - Disconnect stop light cable.
- 2 - Disconnect brake lines and plug them up.
- 3 - Remove bolt that attaches piston push rod to brake pedal and loosen brake pedal stop.



- 2 - Check length of piston push rod (53—52 mm/ 2.09"—2.05" from convex end to nut face).
- 3 - Adjust brake pedal free play by shifting the stop plate until there is a clearance of 1 mm (0.04") between push rod and piston.

- 4 - Remove piston push rod.
- 5 - Remove the two master cylinder mounting bolts and nuts and withdraw master cylinder toward the front.



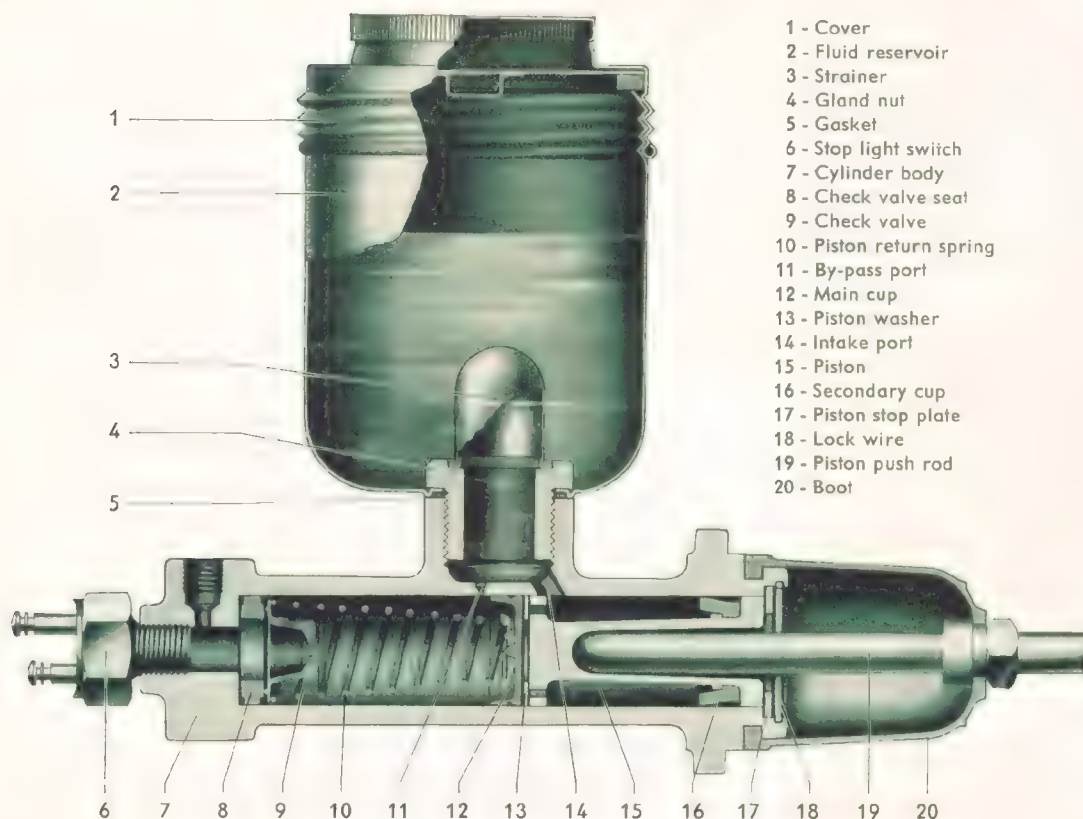
### Installation

This is a reversal of the preceding operations, but attention should be paid to the following points:

- 1 - Place distance sleeves in frame end plate.

- 4 - Top up brake fluid.
- 5 - Bleed the system.
- 6 - Check operation of stop light.

## Reconditioning Master Cylinder



- 1 - Cover
- 2 - Fluid reservoir
- 3 - Strainer
- 4 - Gland nut
- 5 - Gasket
- 6 - Stop light switch
- 7 - Cylinder body
- 8 - Check valve seat
- 9 - Check valve
- 10 - Piston return spring
- 11 - By-pass port
- 12 - Main cup
- 13 - Piston washer
- 14 - Intake port
- 15 - Piston
- 16 - Secondary cup
- 17 - Piston stop plate
- 18 - Lock wire
- 19 - Piston push rod
- 20 - Boot

**Master Cylinder** (Sectional view)

### Disassembly

- 1 - Empty the fluid reservoir, remove and disassemble it.
- 2 - Remove the rubber boot.
- 3 - Remove the lock wire.
- 4 - Take off piston stop plate and piston.
- 5 - Remove piston washer, main cup, return spring, check valve, and seat.
- 6 - Screw off stop light switch.



## Assembly

Assembly is effected by reversing the preceding operations, but the following points should be observed:

- 1 - Clean all parts in denatured alcohol or VW Genuine Brake Fluid. Fuel, paraffin, mineral oil, etc., destroy the rubber parts.
- 2 - Examine all parts for wear. Make sure the intake and by-pass ports are open and free from burrs. Check the piston fit in the cylinder bore.
- 3 - If it is necessary to renew the two rubber cups when rebuilding a master cylinder (Note diameter of master cylinder).
- 4 - Install check valve seat, check valve, return spring and return spring seat.
- 5 - Install piston with VW Genuine Brake Cylinder Paste.
- 6 - See to it that the lock wire is bedding correctly in its recess.
- 7 - When tightening the fluid reservoir in place, be sure the mark (bead) at the bottom of the reservoir points to the stop light switch.
- 8 - Place gasket between fluid reservoir and master cylinder. Check for any leaks.
- 9 - Make sure the vent hole in the fluid reservoir cover is clear of obstruction.



## Description

The wheel cylinders transmit the pressure generated in the master cylinder to the brake shoes.

The wheel cylinder is attached to the brake back plate. The cast cylinder body contains a return spring, two cup fillers, two cups, and two pistons. The return spring and the fillers press the cups against the cylinder wall. When depressing the brake pedal, the fluid displaced by the master cylinder forces the cups and pistons outward, expanding the brake shoes against the drum via the two push rods.

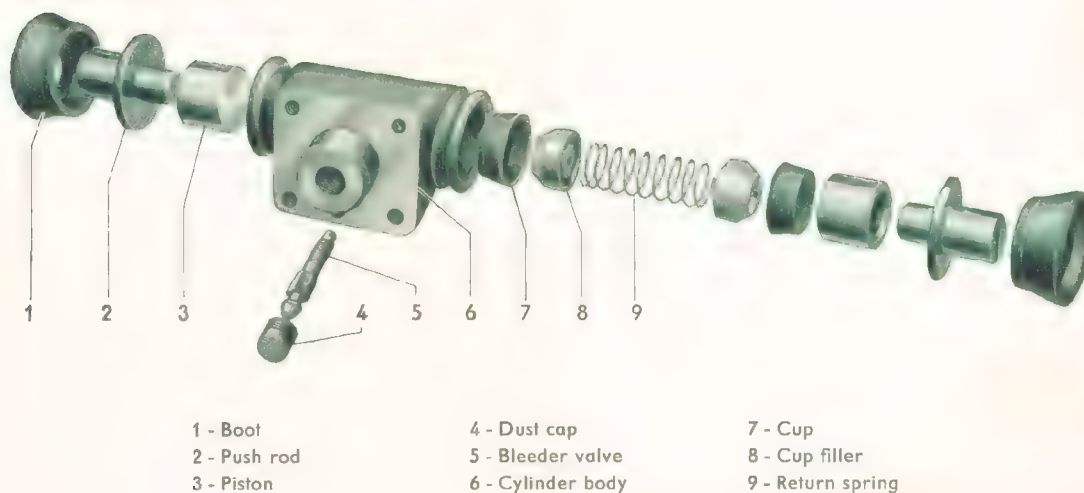
The open ends of the cylinder are fitted with rubber boots to prevent ingress of dirt.

With the brake system at rest, the wheel cylinder is practically filled up, that is, there is no space for the fluid. This insures a perfect bleeding.

Between the pistons is an opening for the bleeder valve, which is turned to the open position when bleeding the system.

**Important!** Note when replacing a wheel cylinder: —

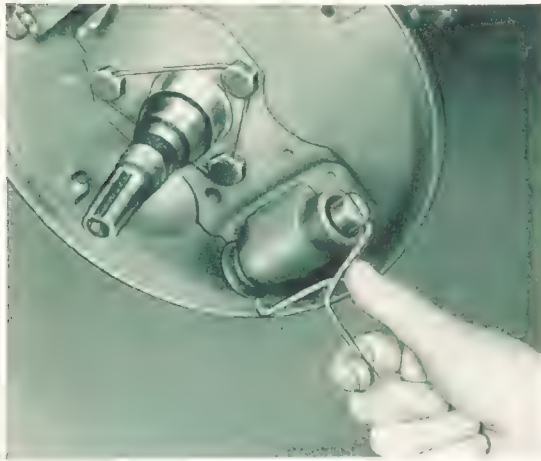
Wheel cylinder, front	19.05 mm (0.75") diam.
Wheel cylinder, rear, up to Chassis No. 167,889	19.05 mm (0.75") diam.
Wheel cylinder, rear, from Chassis No. 167,890	15.87 mm (0.62") diam.
Wheel cylinder, rear, from Chassis No. 397,023	17.46 mm (0.69") diam.



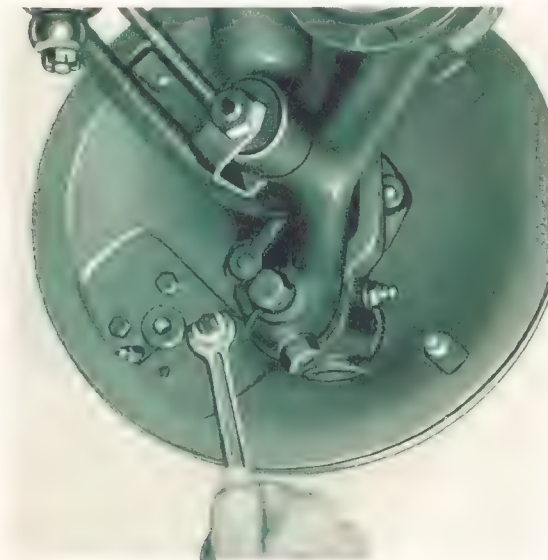
# Front Wheel Cylinder Removal and Installation

## Removal

- 1 - Remove front wheel and brake drum.
- 2 - Disconnect the hose and plug it up by means of a piece of wood.
- 3 - Remove shoe hold-down spring seats, springs, and pins.
- 4 - Unhook brake shoe return springs.
- 5 - Remove brake shoes and place the wheel cylinder clamp in position as shown below.



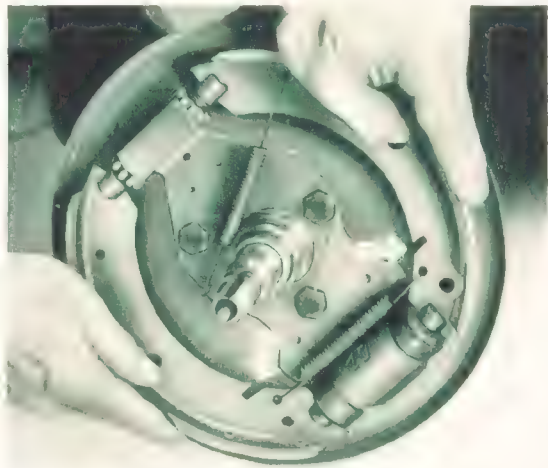
- 6 - Remove the four wheel cylinder attaching screws and take off wheel cylinder.



## Installation

This is a reversal of the preceding operations, but the following points should be noted:

- 1 - Install wheel cylinder. When renewing the wheel cylinder, attention should be paid to the size.
- 2 - Correctly install brake shoes: the slots in the webs must be towards the wheel cylinder.



- 3 - Before installing the brake drum, make sure the oil seal is in perfect condition.
- 4 - Clean brake drum hub and ball bearing and apply Universal Grease VW — A 052.
- 5 - Adjust front wheel bearing as prescribed.
- 6 - Adjust the brakes and bleed the system. Do not forget to re-install the bleeder valve.

## Rear Wheel Cylinder Removal and Installation

### Removal

- 1 - Remove rear wheel, brake drum, and oil deflector.
- 2 - Disconnect brake line and plug it up by means of a piece of wood.
- 3 - Remove shoe hold-down seats, springs, and pins.
- 4 - Unhook brake shoe return springs.
- 5 - Remove brake shoes, brake shoe levers, operating link, and clip. Disconnect brake cable.
- 6 - Install the wheel cylinder clamp in position.
- 7 - Remove the four wheel cylinder attaching screws and take off wheel cylinder.



### Installation

Reverse the removal procedure and observe the following points:

- 1 - Install wheel cylinder. When renewing the wheel cylinder, attention should be paid to the size.
- 2 - Correctly install brake shoes, brake shoe levers, operating link, and clip. The slots in the brake shoe webs must be toward the wheel cylinder. Connect brake cable.
- 3 - When re-installing brake drum, note proper position of oil deflector.
- 4 - Tighten rear axle shaft nut to a torque of between 28 and 31 mkg (203 and 224 ft. lbs.).
- 5 - Bleed the system. Adjust foot and hand brakes. Do not forget to re-install the bleeder valve dust cap.

## Reconditioning Wheel Cylinder

### Disassembly

- 1 - Remove wheel cylinder.
- 2 - Remove both boots.
- 3 - Take off push bars, pistons, cups, cup fillers, and return spring.
- 4 - Screw off bleeder valve.

### Assembly

This is a reversal of the preceding operations, but the following points should be observed:

- 1 - Clean all parts only in denatured alcohol or brake fluid.
- 2 - Examine all parts for signs of wear. Check the piston fit in the cylinder bore.
- 3 - Renew both cups (note diameter of wheel cylinder).
- 4 - Install piston with VW Genuine Brake Cylinder Paste.

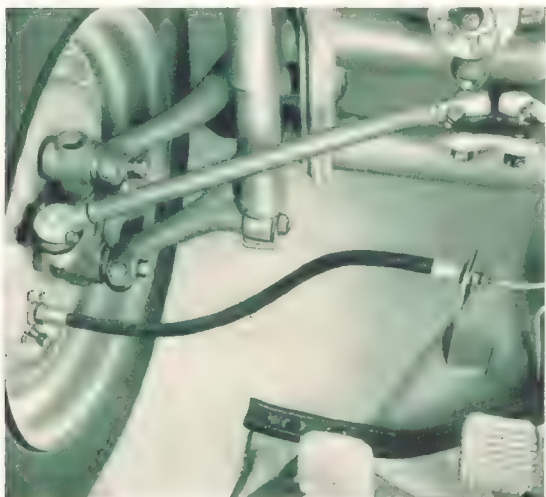


## Brake Hoses

### General

Brake hoses connect the wheel cylinders to the brake lines which are clipped to the frame.

When installing a brake hose, care should be taken to see that there are no sharp bends at the connection. The brake hoses must not be strained



in any steering position nor under springing action of the wheels. The hose should not be allowed to chafe at the chassis or body with the car in motion. It is important to keep the hoses free from contact with paint, fuel, paraffin, or mineral oil.

To prevent the front brake hoses from bending down too far, they should be installed as specified below:

After the brake hose is attached to the brake wheel cylinder, twist the free end of the hose 90° — or max. 180°. The twisting should be done in a way which makes the tube bend toward the **front** of the car.

The instructions should be followed whenever installing brake hoses of the De Luxe and Convertible. However, prior to installing the hoses, raise the car so that the weight is taken off the front wheels.

The nature and amount of damage done to brake hoses indicates in every case some kind of force. The cause lies usually in carelessness during installation.

In order to avoid such damage and to maintain braking efficiency the hints given above should be observed during installation.

Furthermore, care should be taken that grease does not come into contact with the brake hoses when lubricating the front axle.

### Important!

Brake hoses must never be in contact with oil or grease for longer periods.

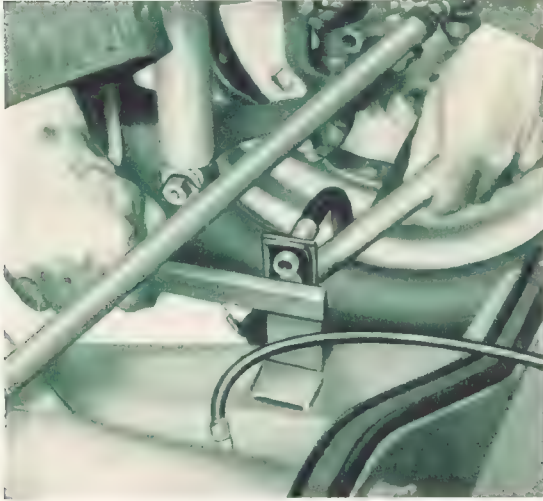
### Important!

The hydraulic system must be bled whenever a fluid line has been disconnected. Top up brake fluid as necessary, using VW Genuine Brake Fluid or Lockheed Brake Fluid.

## Renewing Brake Hose

### Removal

- 1 - Remove wheel.
- 2 - Loosen union nut at hose bracket and remove the hose retainer.



- 3 - Withdraw brake hose from bracket.

- 4 - Disconnect brake hose from wheel cylinder.

### Installation

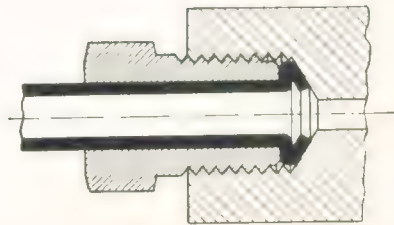
Install the brake hose in the reverse order, observing the following points:

- 1 - The brake hose should not be twisted.
- 2 - Check for proper position of brake hose by turning steering from lock to lock.
- 3 - Bleed the system. Do not forget to re-install the dust cap on the bleeder valve.

## Tubes

### General

The rest of the brake lines consists of steel tubes of 5 x 0.75 mm. No trouble should arise provided the tubing is at all times tightly clipped to the chassis to prevent vibration. The tubes are tested to withstand pressure far in excess of that developed in braking.



### Tube Connections

The tube ends are double flared for added protection against splitting and leakage. They are forced against the beveled faces in the couplings when tightening the coupling nuts, insuring strong and tight joints.

Moisten the flared ends with a few drops of brake fluid prior to tightening the nuts.

Flaring the tubes requires special tools. Before flaring a tube, square off the ends with a tube cutter

and remove any sharp edges. Blow out any metal chips in the tube with compressed air.

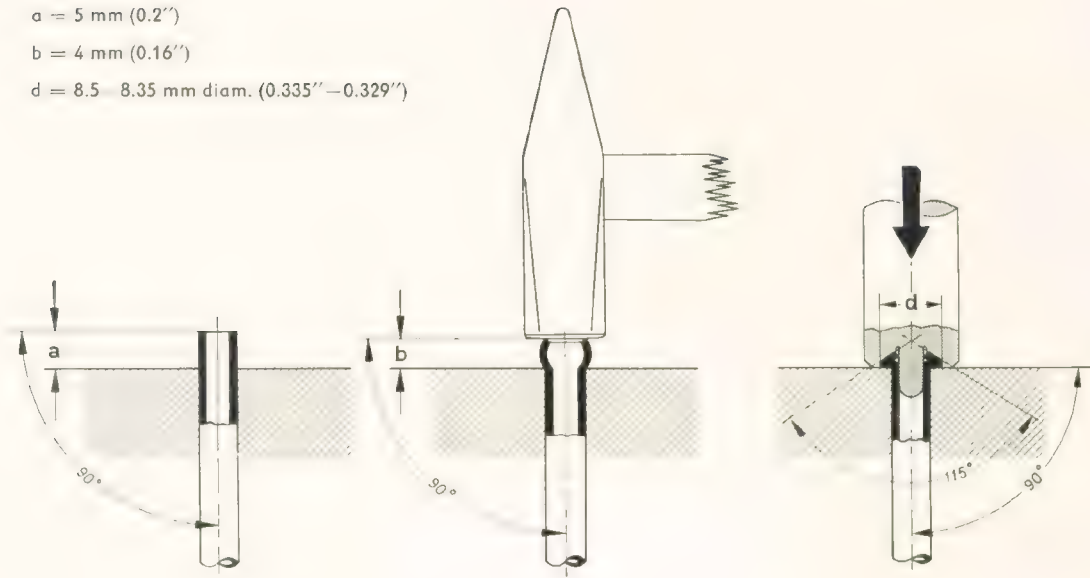
### Important!

When checking the brake system for leaks at routine services, all brake lines should be inspected for signs of corrosion or other damage.

$a = 5 \text{ mm (0.2'')}$

$b = 4 \text{ mm (0.16'')}$

$d = 8.5 - 8.35 \text{ mm diam. (0.335'' - 0.329'')}$





## General

The front and rear wheel brake assemblies are shown in the following illustrations. The rear wheel brake differs from the front wheel brake only by a brake lever at the secondary (trailing) shoe and an operating link between the two shoes.

The brake shoes are self-centralising and are freely resting in the slots of the piston push rods and the adjusting screws, thereby reducing the tendency of the brake to drag to a minimum.

The two shoe hold-down springs assure a constant contact of the shoes with the bosses on the back plate. When letting the pedal return to the "off" position, the brake shoes are pulled to the released position by two return springs.

The brake shoes are adjustable by screws and nuts at the anchor block.

### Note:

From Chassis No. 1—1040548 the brake hose running along the spinal member is additionally protected by a coating of sealing compound (Part No. D 9). When repairs are being carried out this coating should be renewed if necessary. The compound is ready for use and can be applied either by brush or spraying gun. Dilute with benzine if necessary.

Date introduced: 1st December 1955.

From Chassis No. 1436722 the copper-plated brake hoses are additionally galvanized. Thus sufficient protection is provided even after years of service and under unfavorable operating conditions.

Date introduced: 8th February 1957.

In the course of routine maintenance the brake system on older vehicles should be checked regularly for leaks and general condition. Workshop should, therefore, inform their customers of any apparent damage to insure safety in operation.

In case of repair the brake hoses can either be additionally coated with sealing compound or replaced by the latest galvanized ones.

The hole for adjusting the brake has been elongated and displaced by 5 mm (.2").

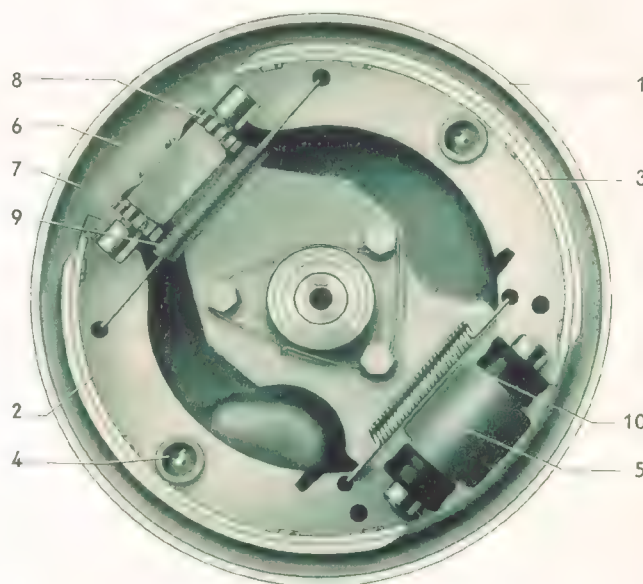
The brake linings can now be checked without dismantling the brake drum. If the linings on inspection during routine maintenance are found excessively worn, i. e., down to about 2.5 mm (.1"), they should be replaced.

Date introduced: 7th March 1956  
From Chassis No.: 1125652

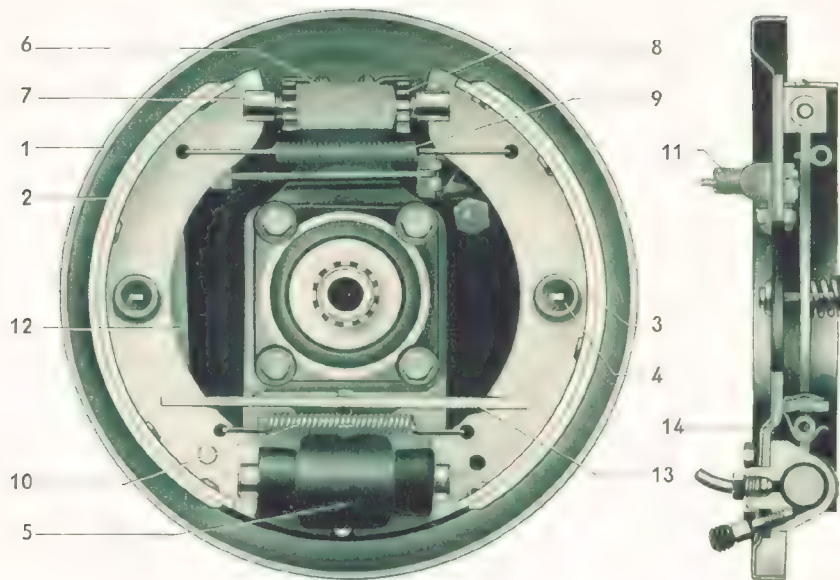
## Wheel Brakes

### Front wheel Brake

- 1 - Brake back plate
- 2 - Secondary (trailing) brake shoe
- 3 - Primary (leading) brake shoe
- 4 - Hold-down spring and spring seal
- 5 - Wheel cylinder
- 6 - Anchor block
- 7 - Adjusting nut
- 8 - Adjusting nut
- 9 - Return spring
- 10 - Return spring



## Rear wheel Brake



- 1 - Brake back plate
- 2 - Secondary (trailing) brake shoe
- 3 - Primary (leading) brake shoe
- 4 - Hold-down spring and spring seat
- 5 - Wheel cylinder
- 6 - Anchor block
- 7 - Adjusting nut

- 8 - Adjusting nut
- 9 - Return spring
- 10 - Return spring
- 11 - Brake cable conduit tube
- 12 - Brake shoe lever
- 13 - Operating link
- 14 - Clip

## Renewing Front Brake Shoes

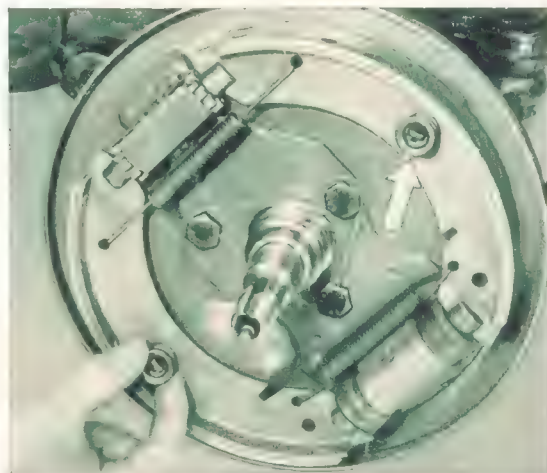
### Removal

- 1 - Remove front wheel and brake drum.
- 2 - Remove shoe hold-down spring seats, springs and pins.
- 3 - Unhook brake shoe return springs.
- 4 - Take off brake shoes.
- 5 - Place wheel cylinder clamp over both push rods.

### Installation

Installation takes place in the reverse order to the instructions on removal, but the following points should be watched closely:

- 1 - When replacing brake shoes, take care the linings are of the same type to insure an equal braking.

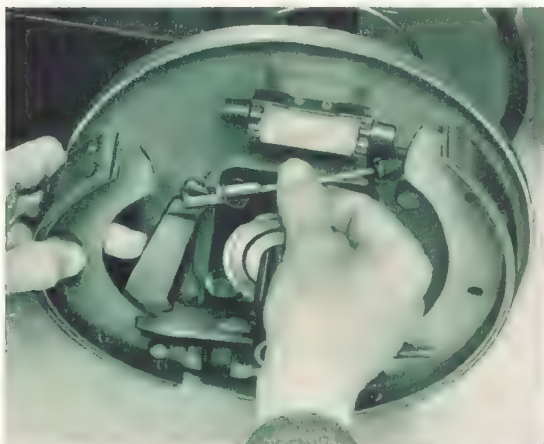


- 2 - Correctly install brake shoes; the slots in the brake shoe webs must be toward the wheel cylinder.
- 3 - Connect return springs so that they do not make contact with other components of the wheel brake.
- 4 - Before installing the brake drum, make sure the oil seal is in perfect condition.
- 5 - Clean brake drum hub and ball bearing and apply Universal Grease VW — A 052.
- 6 - Adjust front wheel bearing as prescribed.
- 7 - Adjust the brakes and bleed the system. Do not forget to re-install the bleeder valve dust cap.

## Renewing Rear Brake Shoes

### Removal

- 1 - Remove rear wheel, brake drum, and oil deflector.
- 2 - Remove shoe hold-down spring seats, springs, and pins.
- 3 - Unhook upper brake shoe return spring.
- 4 - Disconnect brake cable.



- 5 - Remove brake shoes, return spring, brake shoe levers, operating link, and clip.



- 6 - Detach brake lever from brake shoe by removing the circlip from the anchor pin.



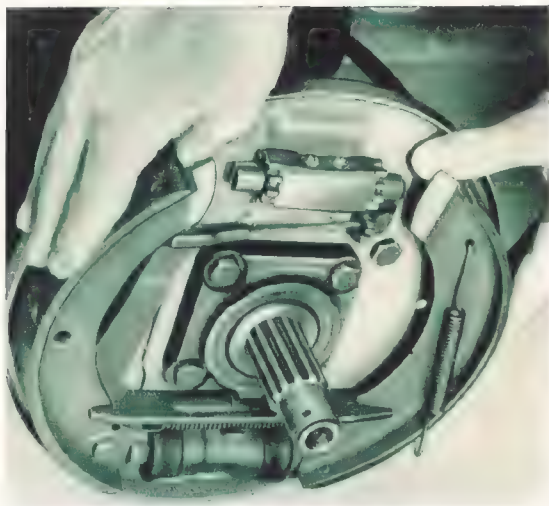
- 7 - Place the wheel cylinder clamp in position.

### Installation

Installation is a reversal of the removal procedure, but the following points should be observed.

- 1 - When replacing brake shoes, take care the linings are of the same type to insure an equal braking.
- 2 - Correctly install brake shoes, return spring, brake shoes levers, operating link, and clip. The slots in the brake shoe webs must be toward the wheel cylinder. Connect brake cable.





- 3 - Connect return springs so that they do not make contact with other components of the wheel brake.
- 4 - When re-installing brake drum, note proper position of oil deflector.
- 5 - Tighten rear axle shaft nut to between 28 and 32 mkg (202 and 224 ft. lbs.).
- 6 - Bleed the system. Adjust foot and hand brakes. Do not forget to re-install the bleeder valve dust cap.

## Lining Replacement

### General

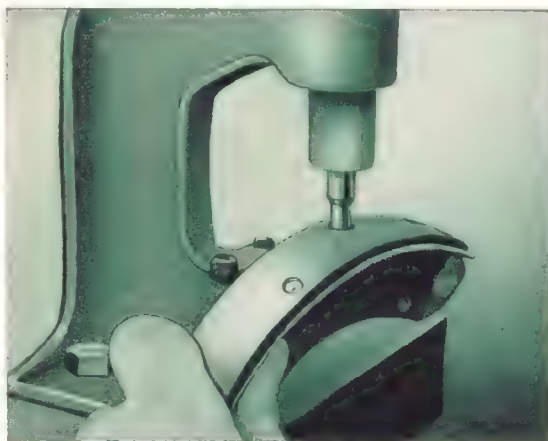
Brake shoe lining replacement should be made only in axle sets (both front wheels or both rear wheels) to insure an equal braking effect. It is also of great importance to use the same type of brake lining to maintain an efficient braking. Oil-soaked brake linings should be replaced. It is of no use to wash the linings in fuel or another grease solvent, as the oil in the lining will again appear on the surface by the heat development when braking.

portant that a snug fit exists between the lining and the shoe, as otherwise brake noises and premature failure of the brakes would be the result.

Only rivets which insure a close fit between the rivet shank and the drilled hole in the lining and shoe should be used.

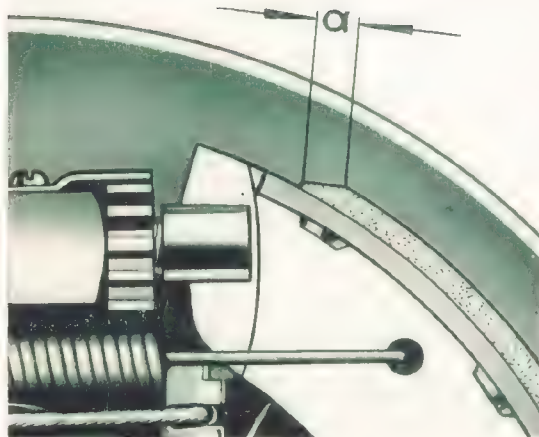
### Relining Brake Shoes

- 1 - Remove brake shoes.
- 2 - Carefully remove the lining rivets to avoid damage and distortion to the brake shoe.
- 3 - Clean and inspect the brake shoe. Remove any burr from rivet holes.
- 4 - The center rivets should be set first, then work towards both ends of the lining. It is very im-



- 5 - Both ends of the lining should be chamfered (5 mm/0.2"). Round off sharp edges of contact surface.

**Important!** — Only use rivets supplied by the VW Factory. Never use aluminium rivets.

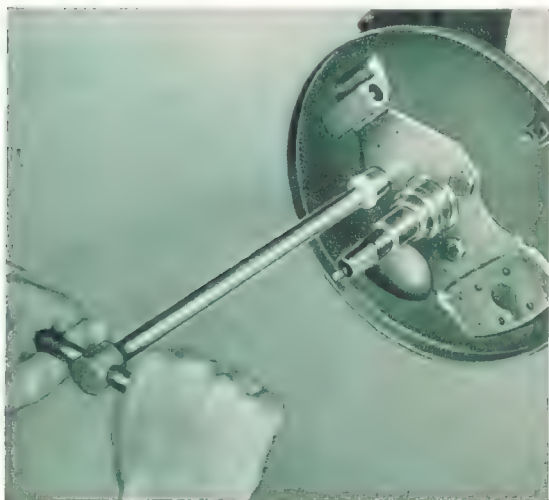


$a = \text{approx. } 5 \text{ mm}/0.2''$

## Removing and Installing Front Brake Back Plate

### Removal

- 1 - Remove front wheel.
- 2 - Remove cotter pin securing speedometer drive cable.  
Remove grease cap.
- 3 - Withdraw brake drum.
- 4 - Disconnect brake hose and plug it up by means of a piece of wood.
- 5 - Remove brake shoes.
- 6 - Remove wheel cylinder.
- 7 - Take off adjusting screws and nuts.
- 8 - Take off the leaf spring on the anchor block after having removed the two attaching screws.

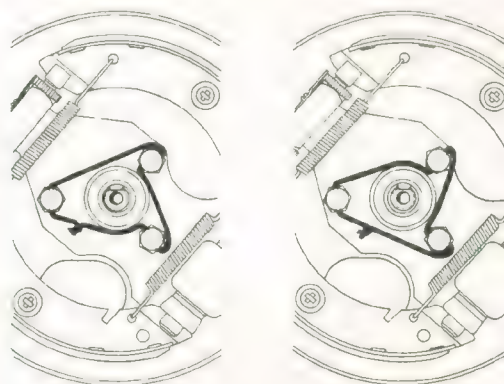


- 9 - Remove the three back plate mounting bolts.
- 10 - Take off back plate.

### Installation

The installation of the back plate takes place in the reverse order to the instructions on removal, but the following points should be watched closely:

- 1 - Thoroughly clean contact surfaces between back plate and stub axle (steering knuckle).
- 2 - Tighten back plate mounting bolt to the following torque:  
Bolts of quality specification 8 G  
4 to 4.5 mkg (29 to 32 ft. lbs.).  
Secure the bolts so as to insure that they do not work loose.



Wrong

Securing Bolts

Correct

- 3 - After the leaf spring on the anchor block has been installed, check its pretension. Bend or renew weak springs.
- 4 - Check if the adjusting screws and nuts can be turned easily. Apply Universal Grease VW — A 052.
- 5 - Before installing the brake drum, make sure the oil seal is in perfect condition.

6 - Clean brake drum hub and ball bearing and apply Universal Grease VW — A 052.

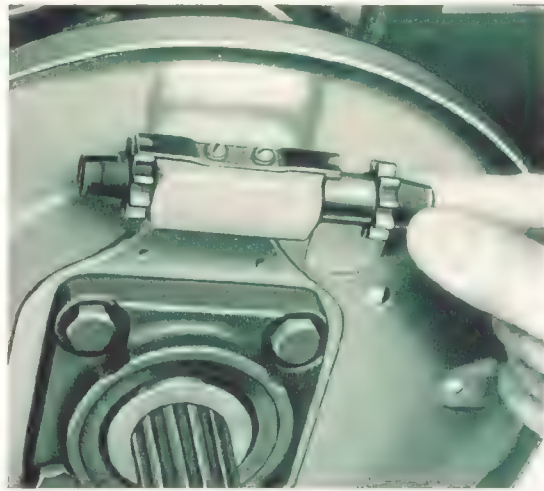
7 - Adjust front wheel bearing as prescribed.

8 - Adjust the brakes and bleed the system. Do not forget to re-install the bleeder valve dust cap.

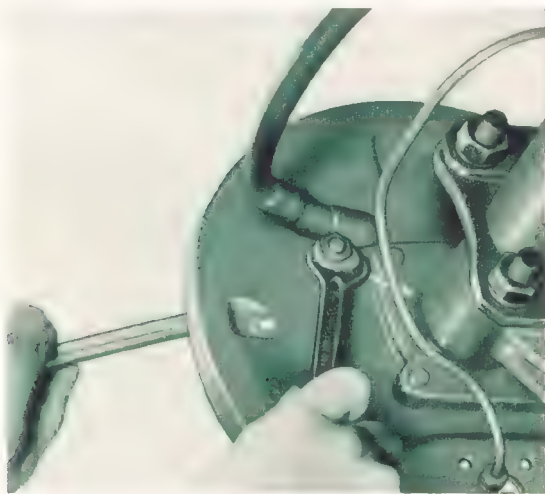
## Removing and Installing Rear Brake Back Plate

### Removal

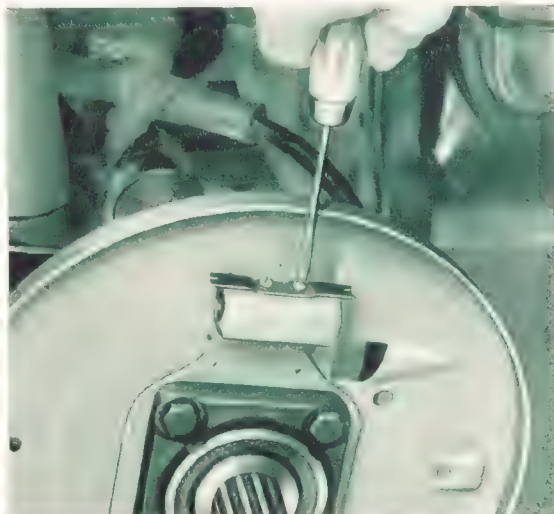
- 1 - Remove brake wheel.
- 2 - Withdraw brake drum.
- 3 - Disconnect brake line and plug it up by means of a piece of wood.
- 4 - Remove brake shoes, brake lever, operating link, and clip. Unhook brake cable.
- 5 - Remove wheel cylinder.
- 6 - Remove brake cable retainer from back plate.



8 - Take off the leaf spring on the anchor block after having removed the two attaching screws.

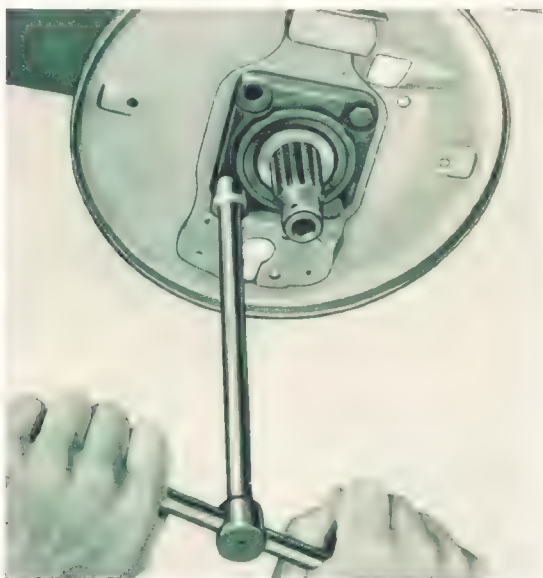


7 - Take off adjusting screws and nuts.





- 9 - Remove the four bolts of the bearing housing cover and take off back plate.



#### Installation

Installation is a reversal of the removal procedure, but the following points should be observed:

- 1 - Thoroughly clean contact surfaces of back plate.
- 2 - Before replacing the bearing housing cover, check condition of oil seal and see to it that it is correctly bedding in its recess. Renew the two gaskets for bearing housing cover and spacer. The oil drop nose of the cover must point downward. Tighten back plate mounting bolts to the following torque:  
  
Bolts of the quality specification 8 G  
4 to 4.5 mkg (29 to 32 ft. lbs.).
- 3 - After the leaf spring on the anchor block has been installed, check its pretension. Bend or renew weak springs.
- 4 - Check if the adjusting screws and nuts can be turned easily. Apply Universal Grease VW — A 052.
- 5 - Correctly install brake shoes; the slots in the webs must be toward the wheel cylinder.
- 6 - When re-installing brake drum, note proper position of oil deflector.
- 7 - Tighten rear axle shaft nut to a torque of between 28 and 31 mkg (202 to 224 ft. lbs.).
- 8 - Bleed the system. Adjust foot and hand brakes. Do not forget to re-install the bleeder valve dust cap.

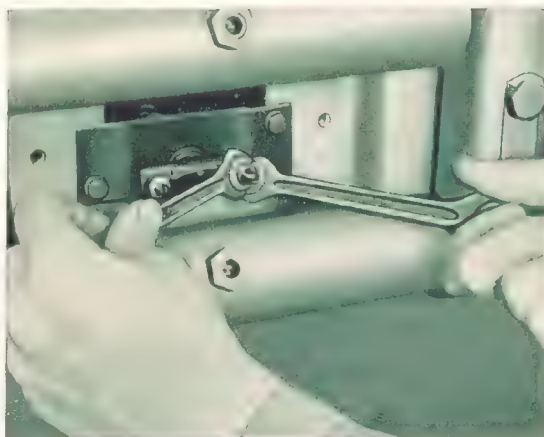
## Removing and Installing Hand Brake Cable

#### General

The hand brake is mechanically operated, acting on the rear wheels. The movement of the hand brake lever is transmitted to the brake levers of the two rear wheel brakes via a brake push bar and two cables.

#### Removal

- 1 - Loosen rear axle shaft nut and wheel mounting bolts.
- 2 - Lift the car and support it on trestles.
- 3 - Take off the wheel and withdraw brake drum and oil deflector.
- 4 - Remove frame head cover. Remove locknut and adjusting nut at front end of brake cable.



- 5 - Remove shoe hold-down spring seats, springs, and pins.
- 6 - Unhook upper brake shoe return spring.
- 7 - Unhook brake cable from brake lever.
- 8 - Remove brake cable retainer from back plate.
- 9 - Withdraw brake cable and conduit tube from back plate.

#### **Installation**

- 1 - Clean brake cable and conduit tube.

- 2 - When renewing the cable, attention should be paid to the length of the new cable.

- 3 - Fill brake cable conduit tubes with Universal Grease VW — A 052.

If there is a grease nipple, the tubes may be filled with the cables in situation.

- 4 - When refitting brake drum, note proper position of oil deflector.

- 5 - Tighten rear axle shaft nut to a torque of between 28 and 31 mkg (202 and 224 ft. lbs.).

- 6 - Adjust hand brake.

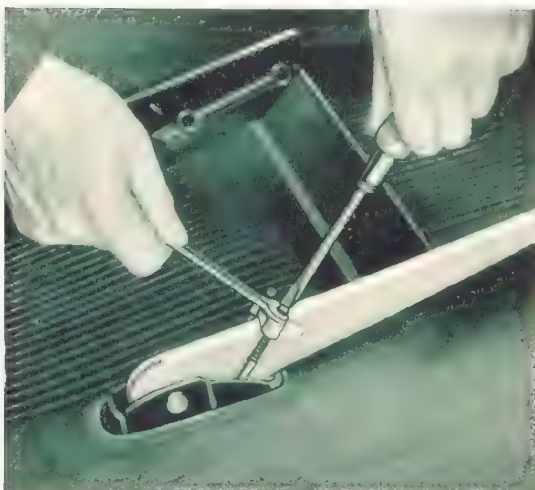
## Hand Brake Lever Removal and Installation

### Removal

- 1 - Pull off hand brake lever rubber boot. To do this, lift the frame tunnel rubber matting.



- 2 - Remove brake cable lock nuts and adjusting nuts.



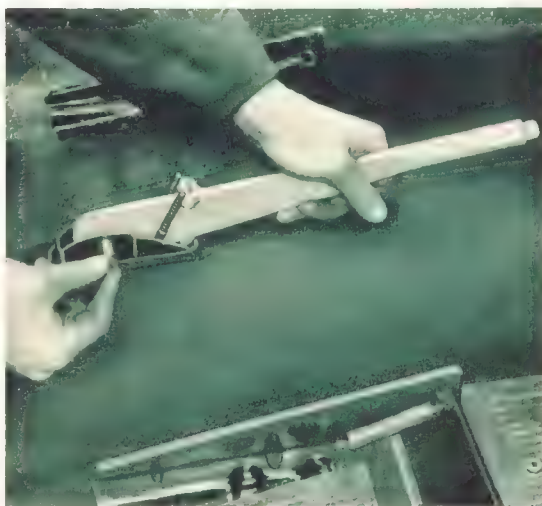
- 3 - Remove one circlip from the hand brake lever pin, and push out the pin.

- 4 - Force hand brake lever rearward without pressing down the release button, until hand brake lever and ratchet can be lifted off.

### Installation

This is a reversal of the above, but it is essential to observe the following points:

- 1 - Prior to installation, disassemble the hand brake lever (pawl rod, release button, pawl rod spring, and ratchet) and clean and grease the components. When installing, be sure the pawl rod nose is correctly positioned in the pawl rod end (A).
- 2 - Install the ratchet so that the notches engage with those of the pawl and the holes for the pin are in line (B).
- 3 - Insert hand brake lever into the opening, and place the threaded end pieces of the cables alongside the lever. Force the hand brake lever rearward until the slot in the ratchet can be made to engage with the edge of the frame tunnel opening (C).
- 4 - Insert hand brake lever pin and install the circlip.

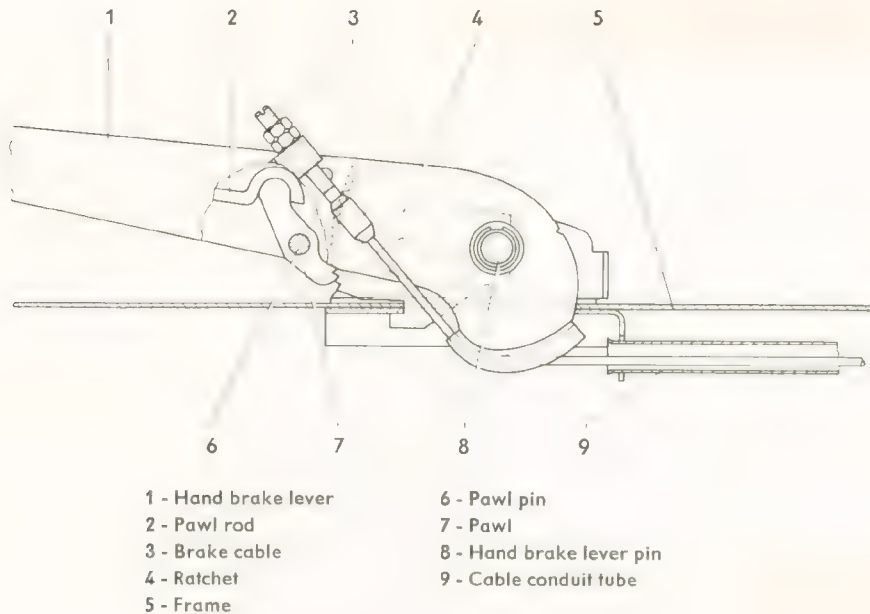




5 - Insert the threaded end pieces of the cables into the cable anchors at the hand brake lever, and screw on the nuts.

6 - Adjust hand brake. Tighten brake cable lock nuts.

7 - Install hand brake lever rubber boot and glue frame tunnel matting in position.



## Hand Brake Cable Removal and Installation

The hand brake cables are anchored direct to the hand brake lever. The cables are guided in conduit tubes to the rear wheels.

### Removal

- 1 - Loosen rear axle shaft nut and wheel mounting bolts.
- 2 - Lift the car and support it on trestles.
- 3 - Remove rear wheel and brake drum.
- 4 - Pull off hand brake lever rubber boot. To do this, lift the frame tunnel rubber matting.
- 5 - Remove brake cable anchor nuts at hand brake lever.

6 - Take off hand brake lever.

7 - Remove brake shoe hold-down spring seats, springs, and pins.

8 - Unhook upper brake shoe return spring.

9 - Remove brake cable retainer from back plate.

10 - Withdraw brake cable and flexible conduit tube from back plate and pull out the cable.

### Installation

This is a reversal of the removal procedure, but the following points should be observed:

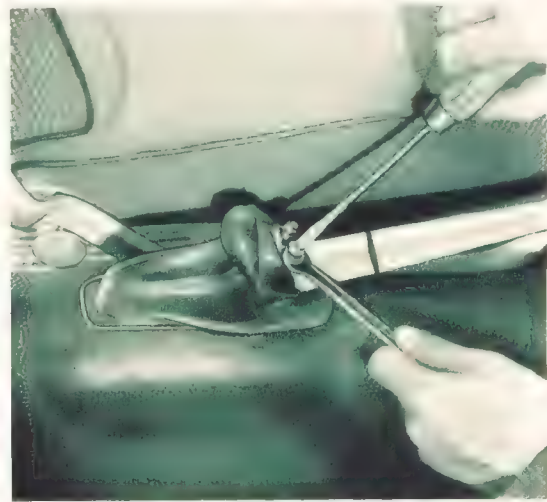
- 1 - Clean brake cable and conduit tube and fill conduit tube with Universal Grease VW—A 052.



- 2 - Insert the hand brake cable into the conduit tube. The threaded end piece must stick out of the frame tunnel opening.
- 3 - Tighten rear axle shaft nut to a torque of between 28 and 31 mkg (202 and 224 ft. lbs.) and secure it with a cotter pin.
- 4 - Adjust hand brake.

## Adjusting Hand Brake

- 1 - Raise the car.
- 2 - Slide off the rubber ring, and fold back the hand brake lever rubber boot until the brake cable adjusting nuts are free.
- 3 - Back off lock nuts and tighten adjusting nuts to a degree which will still allow the rear wheels to turn freely when the hand brake lever is in the released position.
- 4 - Pull up hand brake lever by two notches, and make sure both rear wheels have the same braking effect. At the fourth notch it should be impossible to turn the wheels by hand.
- 5 - Securely tighten lock nuts and fasten hand brake lever rubber boot.



(From August 1957)

## VW Passenger Cars except Standard Model, from Chassis No. 1604758

In connection with the alterations to the frame and pedal cluster the openings for the brake cables in both arms of the frame fork have been placed 50 mm (1.96'') towards the front.

The brake back plates remain the same, but have been turned by 180°. The brake cylinders with bleeder screws are now at the top, and the openings for the brake cables as well as the adjusting screws for the brake shoes are at the bottom. Both brake cables now enter the brake back plates from the front. This made it possible to shorten the conduit tubes for the hand brake cables as well as the hydraulic lines.

With the standard model the brake and the position of the brake back plates have remained unchanged.

Installation of a new frame in place of one of previous design in the **De Luxe, Convertible and Karmann-Ghia Coupé** is only possible if, besides the new pedal cluster, the new brake cables (Part No. 113609721 E) and the new hydraulic lines (Part No. 113611781 A) are installed. The two brake back plates of the rear wheels must be turned by 180° without interchanging them. Torsion bars of previous design may also be used in future.

When installing a new frame together with a pedal cluster of previous design on the **Standard model**, the protruding end of the conduit tube for the accelerator cable must be bent into correct position.

(From October 1957)

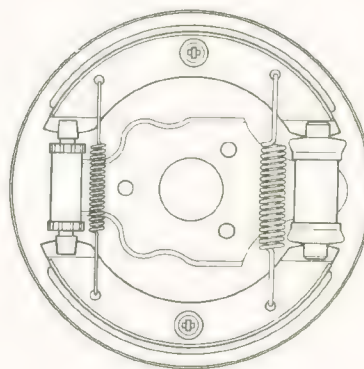
## VW Passenger Cars except Standard Model

The following alterations have resulted in a more favourable distribution of the breaking power:

	Karmann-Ghia Coupé	Convertible	De Luxe Sedan
From Chassis No.:	1665213	1665425	1673351

### Front wheel brake

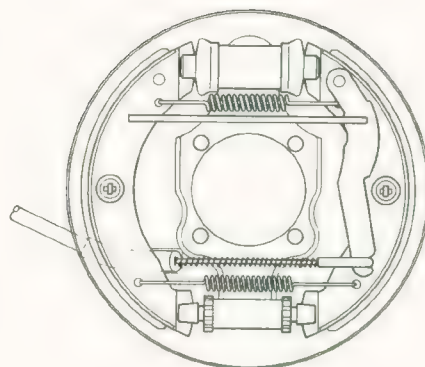
- 1 - The inner diameter of the brake wheel cylinders (Part No. 113611057 A) is 22.2 mm (.874'') (previously: 19 mm/.748'').
- 2 - The width of the brake shoes (Part No. 113609237 C) is 40 mm (1.560'') (previously: 30 mm/1.170''). In the adjusting screws they are no longer mounted at a slant but straight. The brake shoes are mounted horizontally on the brake back plate (previously: at a slant).
- 3 - Instead of three return springs for the brake shoes only two (Part No. 113609301 B/309 B) are installed.
- 4 - The brake back plates (Part No. 113609139 A) are of different shape.
- 5 - The brake drums (Part No. 113405615 A) are wider and have been provided with a reinforcing rib on their circumference. On the inside and outside the drum overlaps the edge of the brake back plate, thus eliminating ingress of dirt and water.





### Rear wheel brake

- 1 - The inner diameter of the brake wheel cylinders (Part No. 113611055 B) is 19 mm/.741" (previously: 17.5 mm/.683").
- 2 - The brake shoes (Part No. 113609537 A) remain 30 mm (1.170") wide and are still mounted vertically. In the adjusting screws they are mounted straight (previously: at a slant).
- 3 - Instead of three return springs two springs (Part No. 113609605 A/309 B) are installed.
- 4 - The brake back plates (Part No. 113609439 B/440 B) are of different shape.
- 5 - The rear wheel bearing seat has been altered: The bearing flange (Part No. 111501163 B/164 B) is turned out deeper. The cover (Part No. 111501311 B) is without a collar and machined to fit onto the reinforcement sheet on the brake back plate.
- 6 - The brake drums (Part No. 113501615 A) are wider and have been provided with a reinforcing rib on their circumference. On the inside and outside the drum overlaps the edge of the brake back plate, thus eliminating ingress of dirt and water.



### Handbrake

- 1 - The handbrake cable is provided with a tension spring (Part No. complete: 113609721 E). From the front it is put through underneath the spring plate and connected to the brake shoe lever (Part No. 113609613 A/614 A) which is mounted at the top of the rear brake shoe. The cable can only be used as replacement for brake cable 113609721 D in cars from Chassis No. 1600440 (1 August 57) onwards.
- 2 - Since 27 June 57, and from Chassis No. 1584415, a galvanized brake shoe lever bolt (Part No. 211609601 A) is installed.

### Track, front

**New:** 1305 mm (50.895") (previously: 1290 mm/50.310")

### Angle of wheels at full lock

**New:** 28°/34° (previously: 26°/32°)

### Note:

Single components of the new brake — with the exception of the handbrake cable — cannot be exchanged for components of older design and vice versa.



## Fillling and Bleeding

### General

The hydraulic system must be topped up and bled whenever a fluid line has been disconnected. Air in the braking system seriously impairs braking efficiency resulting in soft, spongy pedal action. Air is eliminated by adding brake fluid and bleeding the system.

### Brake Fluid

Only VW Genuine Brake Fluid should be used for the hydraulic system of the Volkswagen. It ensures a correct and reliable function of the brakes under all climatic conditions. The VW Genuine Brake Fluid is composed of ingredients which will not derange nor deform the structure or surface of the brake components. Should there be any difficulty to obtain such brake fluid, Lockheed Brake Fluid may be used in lieu of it.

### Brake Cylinder Lubricant

The sealing components of the hydraulic system must not be lubricated with mineral oil or grease. The VW Genuine Brake Cylinder Paste has been introduced to obtain a proper lubrication of the pistons and cylinders. This lubricant does not affect the sealing components of the system and greatly improves the sliding action of the pistons and cups.

Disassemble the cylinder and carefully clean them in denatured alcohol.

When completely dry, the pistons and the cylinder wall should be coated with the brake cylinder paste. Whenever a cylinder has been disassembled, the brake cylinder paste should be applied to the aforementioned parts.

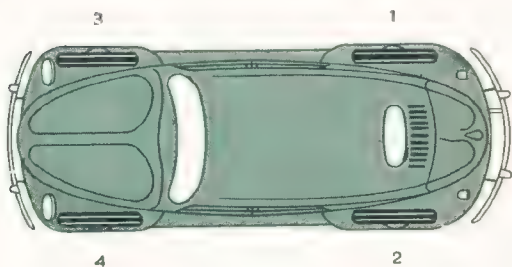
### Bleeding the Brake

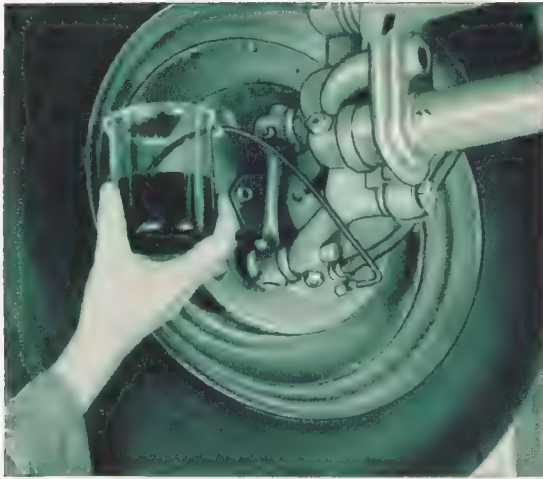
a - The bleeding can best be carried out by two men. Proceed as follows:

1 - Remove bleeder valve dust cap of one of the wheel cylinders.

2 - Attach one end of the bleeder drain hose to the valve.

3 - Allow the free end of the hose to be submerged in a clean glass container partially filled with hydraulic fluid. The end of the drain hose should, if possible, be above the level of the bleeder valve.





4 - Slacken the bleeder valve about one turn, using a 7 mm wrench.

5 - Depress the brake pedal quickly, allowing it to return without assistance, and continue to pump in this manner until the fluid runs out of the bleeder hose in a continuous stream, without air bubbles.

It is extremely important that the master cylinder reservoir be full of fluid and that it be refilled before being completely exhausted.

6 - The brake pedal should be kept in the fully depressed position, until the bleeder valve is closed.

7 - Tighten bleeder valve and replace dust cap.

8 - Repeat the operation on each of the remaining wheel cylinders. If necessary, top up brake fluid in master cylinder after the complete system has been bled.

b - A combined filling and bleeding operation, which may be carried out by one man, be described below:

This operation requires a fill-bleeder tank, manufactured by some firms.

Before starting to bleed, make sure the fill-bleeder tank is sufficiently filled with brake fluid. Then fill the tank with compressed air until the dial indicates 4 to 5 atm. (57 to 71 lbs./sq. in.).

1 - Completely depress brake pedal and fix it in this position.

2 - Remove bleeder valve dust caps of all four wheel cylinders.

3 - Attach free end of tank hose to bleeder valve of left-hand front wheel and slacken bleeder valve about one turn, using a 7 mm wrench.

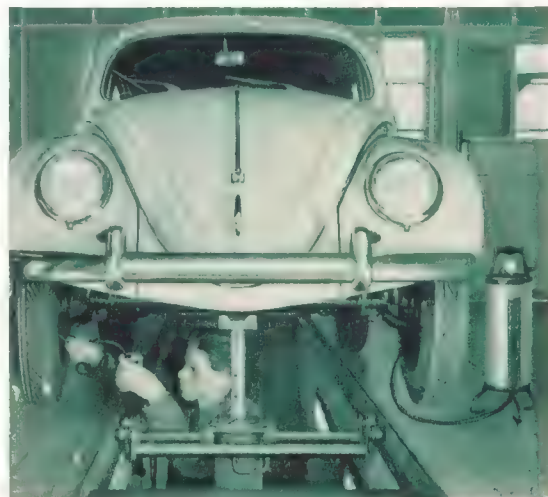
4 - Attach one end of the bleeder drain hose to the bleeder valve of the right-hand rear wheel cylinder and allow the free end of the hose to be submerged in a clean glass container partially filled with hydraulic fluid. Slacken bleeder valve about one turn, using a 7 mm wrench.

5 - Open the shut-off valve in the tank hose and allow the fluid to be bled into the glass container until bubbles cease to appear in the container and the fluid stream is solid.

6 - Tighten bleeder valves.

7 - Close the shut-off valve in the tank hose.

8 - Repeat the operation on the left-hand rear wheel and right-hand front wheel as outlined under 4 to 7.



9 - Replace all bleeder valve dust caps.

10 - Release brake pedal.

11 - If necessary, top up brake fluid in master cylinder after the complete system has been bled.

Also refer to manufacturer's instructions for operation of fill-bleeder tank.



It is not recommended to reuse the brake fluid in the glass container. It may be contaminated or dirty. Foreign matter in the brake fluid seriously impairs braking efficiency. If reusing the fluid, it should be filtered thoroughly through blotting-paper.

#### Flushing the system

To flush the system, only use brake fluid, never fuel or mineral oil. Even the use of alcohol is not recommended, as the flushing agent cannot be completely removed. When refilling the system, the remaining alcohol will mix with the brake fluid leading to vapour locks at higher temperatures of the system.

## Adjusting Wheel Brake

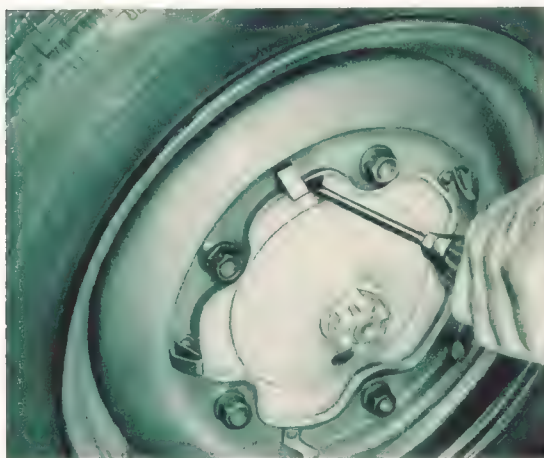
### General

Brakes require periodic adjustment to assure their proper operation. Too much free travel of the brake pedal is an indication that the clearance between brake shoes and brake drums has become too great and that the brakes need adjustment. This adjustment will usually compensate for such wear that will take place until relining of the shoes is required.

Before carrying out any adjustments of the brakes, check the front wheel bearing play.

### Adjustment

- 1 - Raise the car and release hand brake.
- 2 - Prior to adjusting, completely depress the brake pedal several times, to allow the brake shoes to centralize in the drums.
- 3 - Turn forward the wheel to be adjusted until



the hole in the brake drum is in line with one of the adjusting nuts.

- 4 - Insert a screwdriver through the hole and turn the adjusting nut, using screwdriver as a lever, until a light drag is noted when wheel is turned by hand. Back off adjusting nut 3 to 4 teeth to allow the wheel to turn freely.

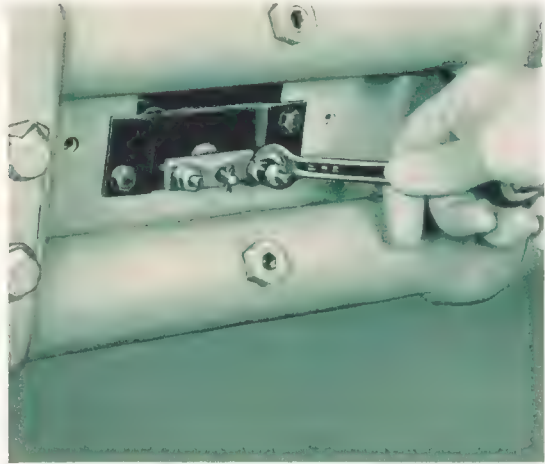


- 5 - Repeat the procedure on the other adjusting nut. Note the opposite turning direction of the two nuts.
- 6 - Repeat the above operations on the other wheels.
- 7 - Road-test the car.

# Adjusting Hand Brake

## Adjustment

- 1 - Raise the car.
- 2 - Remove frame head cover.
- 3 - Back off locknuts at front end of brake cables and tighten adjusting nuts to a degree which will still allow the rear wheels to turn freely when the hand brake is released.
- 4 - Pull up hand brake lever by two notches and make sure both rear wheels have the same braking effect. At the fourth notch it should be impossible to turn the wheel by hand.
- 5 - Securely tighten locknuts.





## Brake Trouble Checking

Symptom	Cause	Remedy
Pedal goes to floorboard.	Normal lining wear.	Adjust shoes.
Spongy response at brake pedal.	a - Air in the system. b - Lack of fluid in master cylinder reservoir.	a - Bleed the system. b - Top up fluid level.
Pedal goes to floorboard without brake action, even though the system has been bled and adjusted.	a - Check valve in master cylinder in-operative. b - Check valve seat dirty.	a - Renew the check valve. b - Clean or renew check valve seat.
Brake action is obtained only by pumping pedal several times.	a - Air in the system. b - Weak piston return spring.	a - Bleed the system. b - Renew piston return spring.
Brake action decreases and pedal goes to floorboard, even though the brakes have been adjusted.	a - Fluid leak in the system. b - Damaged or unserviceable cups in master or wheel cylinder.	a - Locate point of leakage and repair. b - Replace faulty cups.
Brakes drag.	a - By-pass port in master cylinder clogged. b - Too less a clearance between piston push rod and master cylinder piston. c - Shoe return springs broken or weak. d - Improper brake fluid.	a - Clean the master cylinder. b - Adjust brake pedal play. c - Replace springs and adjust shoes. d - Drain the fluid, remove all rubber parts, and flush the system with proper brake fluid. Install new rubber parts, including check valve and seat.

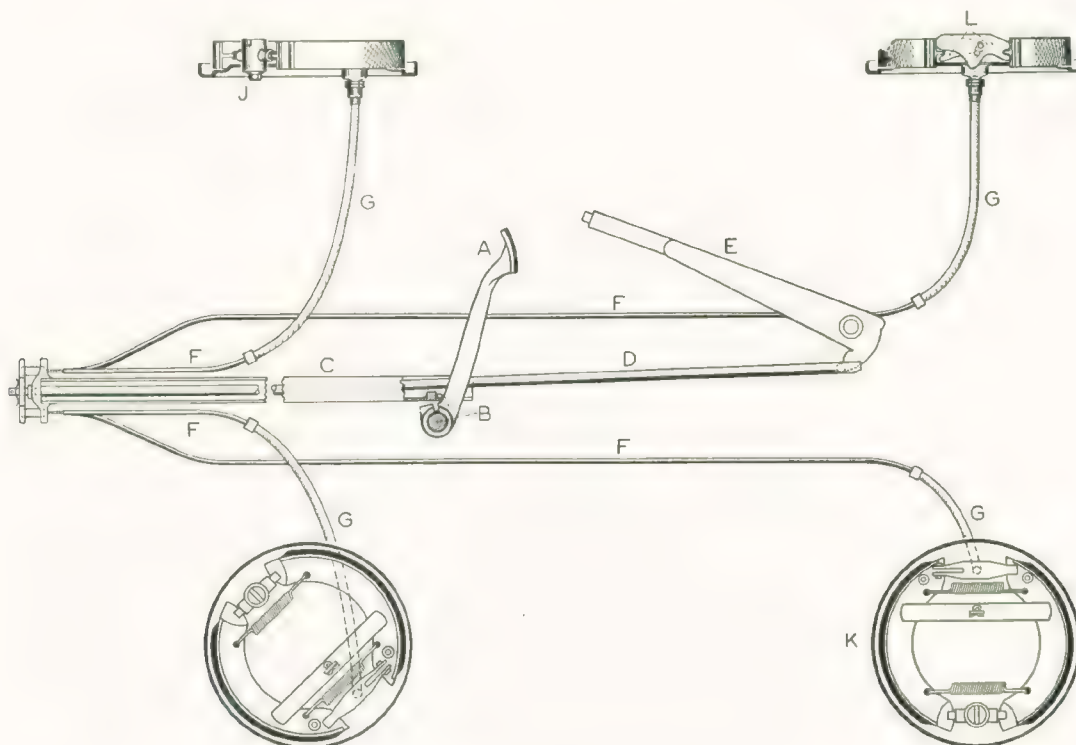


Symptom	Cause	Remedy
Excessive pressure on pedal, poor stop.	a - Oil on brake shoe lining. b - Improper brake shoe lining.	a - Replace lining. Locate point of leakage and clean wheel brake. b - Replace lining, use genuine spare parts.
Brakes tie up while driving.	a - By-pass port in master cylinder not free (possibly caused by a deformed cup). b - Improper brake fluid. c - Incorrect position of brake pedal stop plate.	a - Clean by-pass port by means of a piece of suitable wire. Remove any burr. Replace cup. b - Drain the fluid, flush the system and refill with proper brake fluid. c - Check position of brake pedal and adjust the pedal play so as to ensure that the by-pass port is not closed by the piston cup.
Brakes uneven.	a - Brake drum eccentric. b - Tires not properly inflated or worn. c - Oil on brake shoe lining.	a - Replace brake drum or remachine it. b - Check tire pressure and replace worn tires. c - Replace lining. Only replace in axle sets (both front wheels or both rear wheels).
Brakes chatter and tend to tie up.	a - Brake shoe lining not chamfered at ends. b - Brake shoe lining worn, rivets make contact with the drum. c - Brake drum eccentric.	a - Genuine VW lining is correctly chamfered. b - Replace lining or reset the rivets. c - Replace brake drum or remachine it.
Brakes noisy.	a - Improper brake shoe lining. Lining not chamfered at ends. b - Lining loose on shoe. c - Brakes dirty.	a - Reline the shoes. Use Genuine VW Spare Parts. b - Reline the shoes. c - Clean wheel brakes.

## General

The foot and hand brakes operate through mechanical linkage to all four wheels. The force applied at the brake pedal or hand lever is transmitted to the wheels by four cables, which pass through conduit tubes in the tubular backbone of the frame. Between the frame and the wheels, the cables are well protected from dirt, splash water and stones by flexible metal tubes, which in turn are covered by protective hoses. The brake shoes are forced against the drums by one expanding device at each wheel.

One adjusting device at each brake back plate compensates for such wear that will take place until relining of the shoes is required.



Diagrammatic view of mechanical brake

- |                              |                                 |
|------------------------------|---------------------------------|
| A - Brake pedal              | G - Flexible metal tube         |
| B - Brake pedal shaft        | H - Front wheel brake           |
| C - Foot brake push bar      | J - Adjusting device            |
| D - Hand brake push bar      | K - Rear wheel brake            |
| E - Hand brake lever         | L - Brake shoe expanding device |
| F - Brake cable conduit tube |                                 |

### The brake system consists of:

- a - Brake pedal with pedal shaft and foot brake push bar.
- b - Hand brake lever with ratchet and hand brake push bar.
- c - Four brake cables.
- d - Brake back plate with adjusting and expanding device and brake shoes.

## Operation

### Foot brake

Pressing down on the brake pedal pulls against cables attached to the head of the brake push bar at the one end and to the brake shoe expanding devices at the other. The nose at the brake pedal shaft pushes the foot brake bar toward the front which actuates the cables to operate the expanding devices, forcing the shoes against the drums. When releasing the brake pedal, the brake shoes return to their original position by springs.

### Hand brake

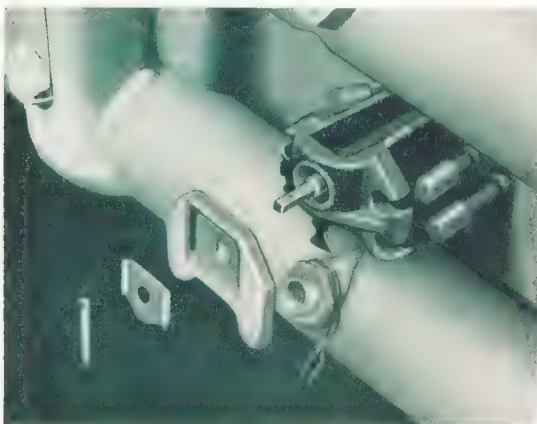
The hand brake is operated by pulling up the lever, which can be fixed by a ratchet. When pulling the lever, the hand brake push bar forces the foot brake push bar towards the front and the cables actuate the wheel brakes as described under "foot brake".



## Removing and Installing Foot Brake Push Bar and Hand Brake Push Bar

### Removal

- 1 - Lift the front end of the car, release hand brake and remove spare wheel.
- 2 - Remove front shock absorbers.
- 3 - Remove frame head cover.
- 4 - Disconnect cable at stop light switch and remove stop light switch.
- 5 - Remove cotter pin, plate, and cover at brake cable junction head.
- 6 - Unhook brake cables.



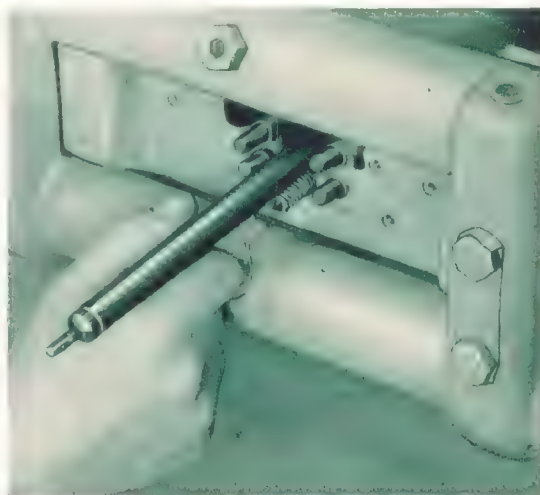
- 7 - Unhook return spring of foot brake push bar by means of a piece of wire and attach it to the lock nut of the torsion bar center anchor as shown above.
- 8 - Withdraw foot brake push bar and hand brake push bar through the provided holes in the body.



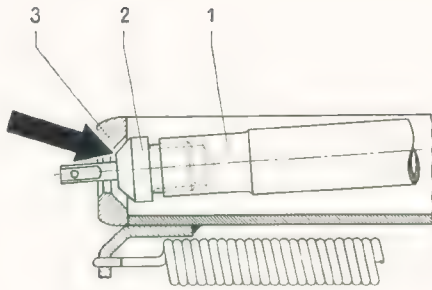
### Installation

This is a reversal of the removal procedure, but the following points should be observed:

- 1 - Grease adjusting screw of hand brake push bar and check if it can be easily turned.
- 2 - Insert the hand brake push bar in the opening of the frame head and push the slotted end along the right-hand side (seen in driving direction) of the frame tunnel until the ball of the hand brake lever engages in the slot of the push bar. When the push bar can no longer be turned, this is an indication that the ball is properly engaged.



- 3 - Check foot brake push bar for wear and twist and replace it if necessary.
- 4 - Grease foot brake push bar with Universal Grease VW — A 052. When fitting the foot brake push bar, take care the nose of the brake pedal shaft engages in the slot and the hand brake push bar engages in the hole of the foot brake push bar. The correct assembly can best be controlled by a second mechanic moving the foot pedal and the hand brake lever.
- 5 - Connect push bar return spring.
- 6 - Adjust correct play of 1 mm (0.04'') between hand brake push bar and foot brake push bar by turning the adjusting screw.



- 1 - Hand brake push bar
- 2 - Adjusting nut
- 3 - Foot brake push bar

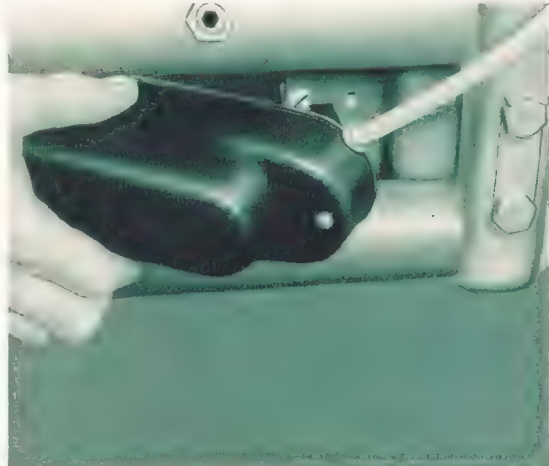
**Note.** — There should be a free play of half a notch at the hand brake lever to ensure that the cables are free of tension with the lever in the released position.

- 7 - Attach brake cables to the junction head of the foot brake push bar, taking care the conduit hoses occupy a correct position.

- 8 - Secure brake cables by means of cover, plate, and cotter pin.

- 9 - Install stop light switch and check its setting.

- 10 - See to it that the rubber grommet for the stop light switch cable is properly seated in the frame head cover.



- 11 - Check brakes and adjust if necessary.

## Removing and Installing Hand Brake Lever

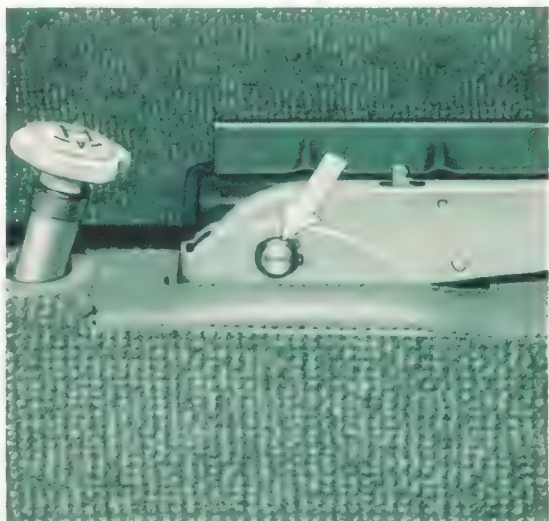
### Removal

- 1 - Withdraw both push bars about 10 cm (4") towards the front.



- 2 - With the De Luxe Model, take off the hand brake lever boot by lifting the carpet.

- 3 - Remove one circlip from the hand brake lever pin.

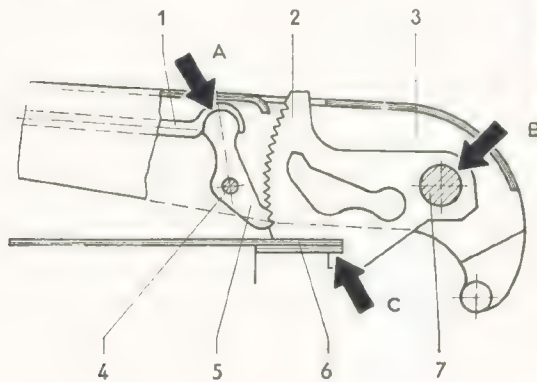


- 4 - Press down the release button on the pawl rod and remove hand brake lever pin.
- 5 - Keep the release button in the depressed position and lift the hand brake lever and ratchet towards the rear.

### Installation

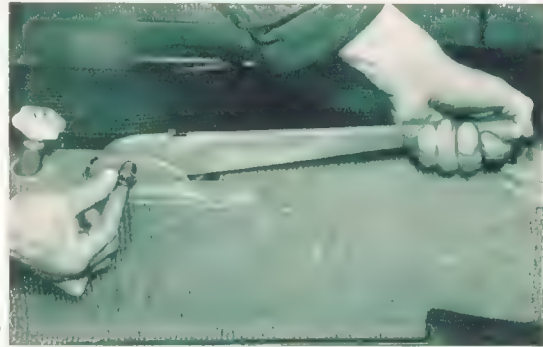
Replacement is a reversal of the above, but it is essential to observe the following points:

- 1 - Prior to the installation, disassemble the hand brake lever (pawl rod and release button, pawl rod spring and ratchet), clean and grease the components and reassemble the lever. Note correct position of pawl nose in the pawl rod end (A).



- |                      |                          |
|----------------------|--------------------------|
| 1 - Pawl rod         | 5 - Pawl                 |
| 2 - Ratchet          | 6 - Frame                |
| 3 - Hand brake lever | 7 - Hand brake lever pin |
| 4 - Pawl pin         |                          |

- 2 - Install the ratchet so that the notches engage with those of the pawl and the holes for the pin are in line (B).
- 3 - When installing the hand brake lever, the slot in the ratchet must grip over the metal of the frame (C).
- 4 - Press down the release button until the hand brake lever pin is installed.



- 5 - Check and, if necessary, adjust the prescribed play between hand brake push bar and foot brake push bar (approx. 1 mm = 0.04").
- 6 - Install stop light switch and check its adjustment.
- 7 - See to it that rubber grommet for the stop light switch cable is correctly seated in the frame head cover.
- 8 - Check brakes and adjust if necessary.



## General

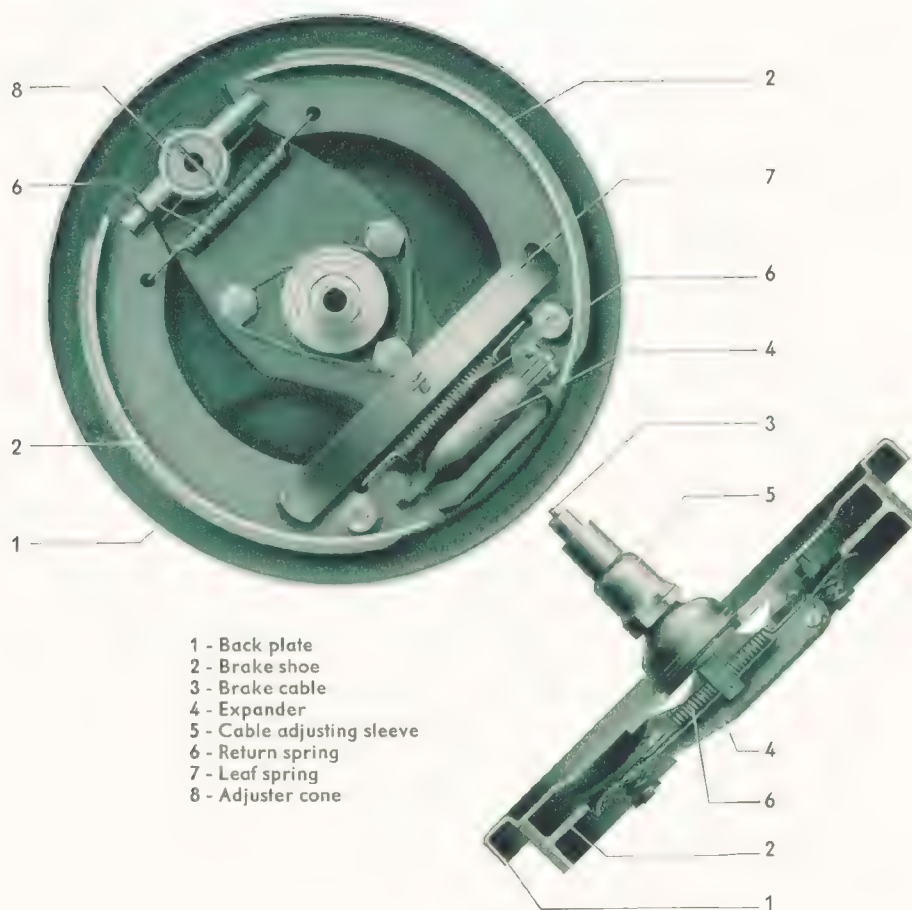
The front and rear wheel brake assemblies are illustrated by the following pictures. The rear wheel brake differs from the front wheel brake by the position of the shoes and the brake shoe adjusting and expanding device at the back plate.

The brake shoes are held in position by spring-loaded pins and returned to the released position by two return springs. A leaf spring maintains the contact between the shoes and the back plate.

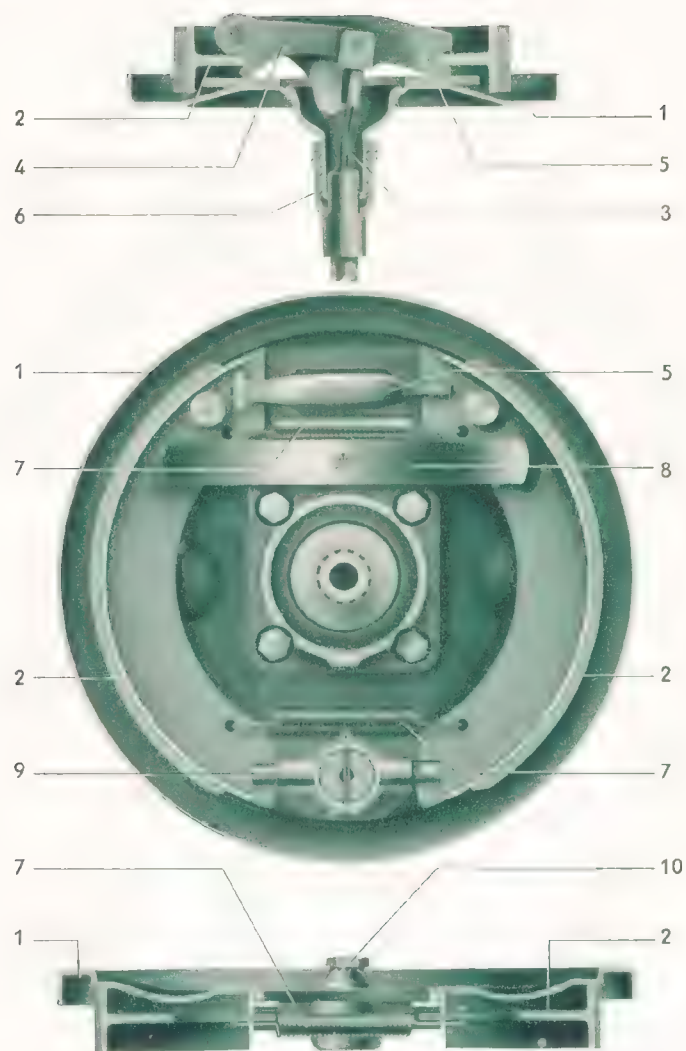
The adjusting screw allows a correct adjustment of the shoes in conjunction with the adjuster cone.

## Wheel Brake

### Front wheel brake



## Rear wheel brake

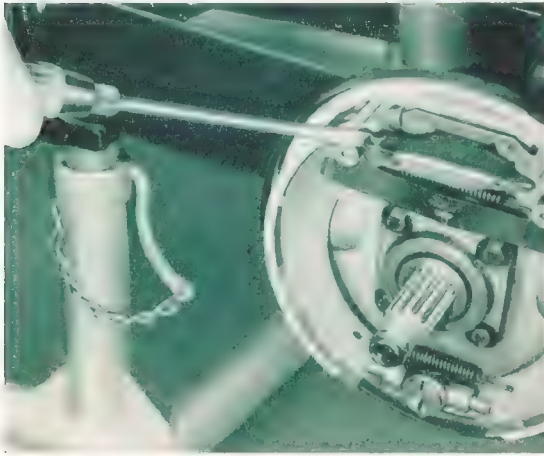


- 1 - Back plate
- 2 - Brake shoe
- 3 - Brake cable
- 4 - Brake shoe lever
- 5 - Expander
- 6 - Cable adjusting sleeve
- 7 - Return spring
- 8 - Leaf spring
- 9 - Adjuster cone
- 10 - Adjusting screw

## Removing and Installing Operating Lever and Expander

### Removal

- 1 - Raise the car.
- 2 - Remove wheel and brake drum.
- 3 - Lever off expander and operating link by means of a screwdriver.

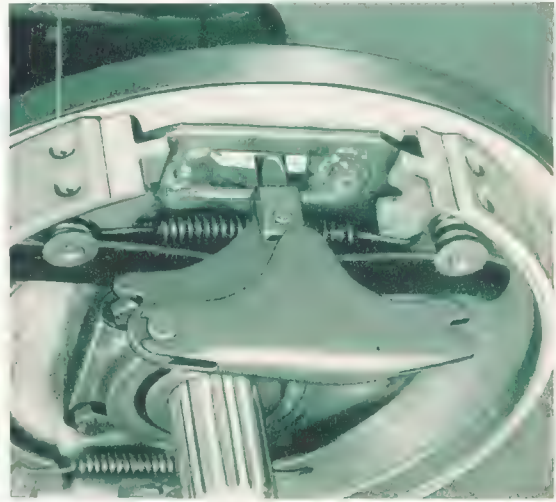


- 4 - Remove pin for expander and operating link and pin for brake cable and operating lever.

### Installation

Installation is a reversal of the preceding operations, but the following points should be observed:

- 1 - Lightly grease all moving joints at expander and operating link with Universal Grease VW — A 052.
- 2 - Install operating link and expander, making sure the pin is toward the front at the rear wheel brakes and toward the rear at the front wheel brakes.



- 3 - Adjust brakes.

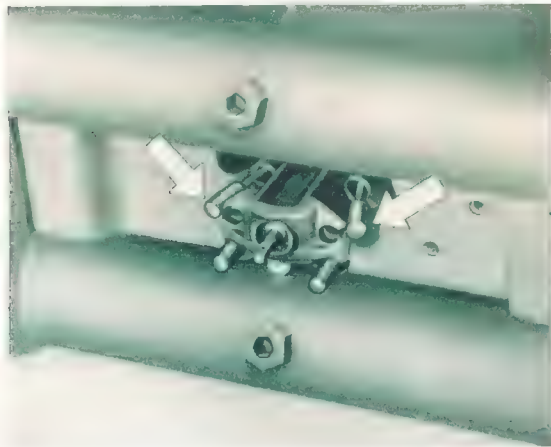
## Removing and Installing Brake Cables

### Removal (Front wheels)

- 1 - Lift car and support it on trestles.
- 2 - Remove hub cap and grease cup. At lefthand wheel hub: first remove cotter pin securing speedometer cable.
- 3 - Turn up lock plate and remove hub nut. Pull off brake drum, using Special Tool VW 202 in conjunction with VW 202c, 202d and 202i.
- 4 - Lever off operating link and expander by means of a screwdriver.
- 5 - Remove pin that connects brake cable to operating link and withdraw cable from back plate through the adjusting sleeve.
- 6 - Remove frame head cover, cotter pin, plate, and cover at brake cable junction head.



- 7 - Disconnect cable at stop light switch and remove stop light switch.
- 8 - Unhook brake cable for front wheel. Pull up the hand brake lever and withdraw cable from the conduit tube toward the rear.



#### Installation

Reverse the removal procedure, while observing the following points:

- 1 - Check brake cable for damage and grease it with Universal Grease VW — A 052. If necessary, apply a rust solvent to ensure a free movement of the cable.
- 2 - See to it that the brake shoes and return springs are correctly positioned.
- 3 - Adjust front wheel bearings as described in the section "Front Axle".
- 4 - Check setting of stop light switch. If necessary, reset as outlined in the section "Electrical System".
- 5 - Adjust brakes.

#### Removal (Rear wheels)

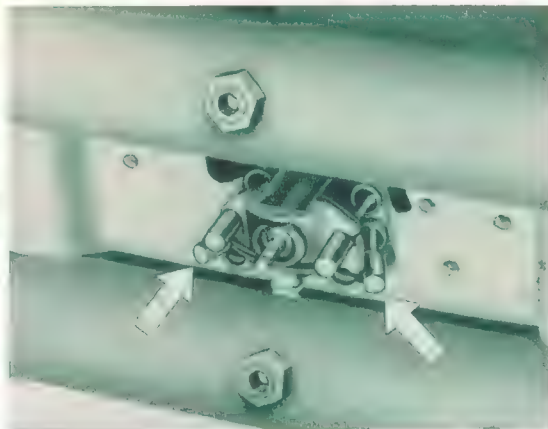
- 1 - Lift car and support it on trestles.
- 2 - Remove hup cap and cotter pin at rear axle shaft nut.
- 3 - Remove rear axle shaft nut and take off wheel, brake drum, and oil deflector.
- 4 - Lever off operating link and expander by means of a screwdriver.

- 5 - Remove pin that connects brake cable to operating link and withdraw cable from back plate through the adjusting sleeve.

- 6 - Remove frame head cover, cotter pin, plate, and cover at brake cable junction head.

- 7 - Disconnect cable at stop light switch and remove stop light switch.

- 8 - Unhook brake cable for rear wheel. Pull up the hand brake lever and withdraw cable from the conduit tube toward the rear.



#### Installation

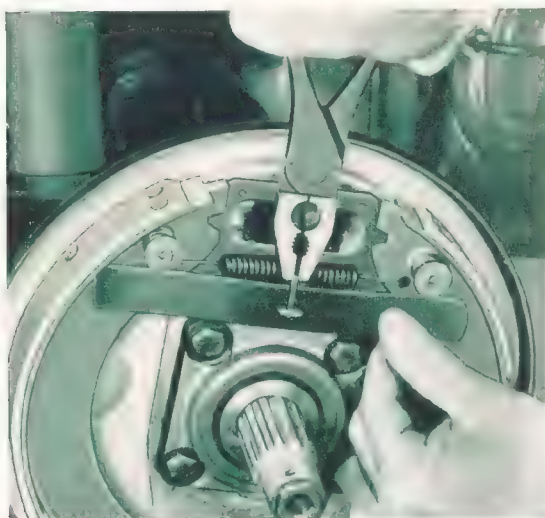
This is accomplished by reversing the above procedure, but attention should be paid to the following points:

- 1 - Check brake cable for damage and grease it with Universal Grease VW — A 052. If necessary, apply a rust solvent to ensure a free movement of the cable.
- 2 - See to it that the brake shoes and return springs are correctly positioned.
- 3 - When installing the brake drum, make sure the oil deflector occupies its proper position.
- 4 - Tighten rear axle shaft nut to a torque of between 28 and 31 mkg (202 and 224 ft. lbs.).
- 5 - Check setting of stop light switch. If necessary, reset as outlined in the section "Electrical System".
- 6 - Adjust brakes.

## Removing and Installing Brake Shoes

### Removal

- 1 - Raise the car.
- 2 - Remove wheel and brake drum.
- 3 - Remove expander and operating link.
- 4 - Remove cotter pin and take off leaf spring for brake shoes.



- 5 - Swing down the shoes and withdraw them from the locating pins.

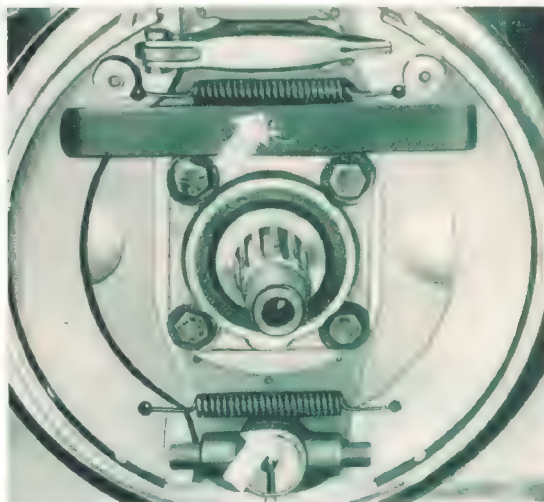


- 6 - Remove brake shoe locating pins.

### Installation

Installation is a reversal of the above procedure, but the following points should be observed:

- 1 - Inspect condition of adjuster cone, cotter pin and adjusting screw; replace as necessary. Lubricate adjuster cone and adjusting screw with Universal Grease VW — A 052.
- 2 - Grease locating pins and install them with the oblique ends toward the adjuster cone.
- 3 - When exchanging brake shoes, take care that the brake shoe linings are of the same type on both wheels of the axle to maintain an efficient braking.
- 4 - Install brake shoes, the spring-loaded retaining pins must bed in the recesses provided in the reinforcement plate.
- 5 - Hook return springs in position as shown below so that they do not make contact with another part.



- 6 - Slightly grease contact points of leaf spring.
- 7 - Install operating link and expander, making sure the pin is toward the front at the rear wheel brakes and toward the rear at the front wheel brakes. Grease the joints of the operating link and expander.
- 8 - With the front wheels, clean brake drum hub and ball bearings and refill with Universal Grease VW — A 052.
- 9 - Adjust brakes.

# Lining Replacement

See section “**Hydraulic Brake**”, page 5-4

## Removing and Installing Front Brake Back Plate

### Removal

- 1 - Raise the car.
- 2 - Remove front wheel.
- 3 - Left front wheel: remove cotter pin securing speedometer cable.  
Remove grease cup.
- 4 - Remove brake drum.
- 5 - Remove expander and operating link.
- 6 - Withdraw brake cable from back plate.
- 7 - Remove cotter pin and brake shoe leaf spring.
- 8 - Remove brake shoes and return springs.
- 9 - Remove brake shoe locating pins.
- 10 - Remove the three back plate mounting bolts.
- 11 - Take off back plate.

### Installation

This is a reversal of the preceding operations, but the following points should be observed:

- 1 - Grease cable adjusting sleeve and lock nut as well as adjusting screw and cone at brake back plate. If necessary, renew adjuster cone cotter pin.

- 2 - Tighten back plate mounting bolts to the following torques:

Bolts of quality specification 8 G  
to 4—4.5 mkg (29—32 ft. lbs.).

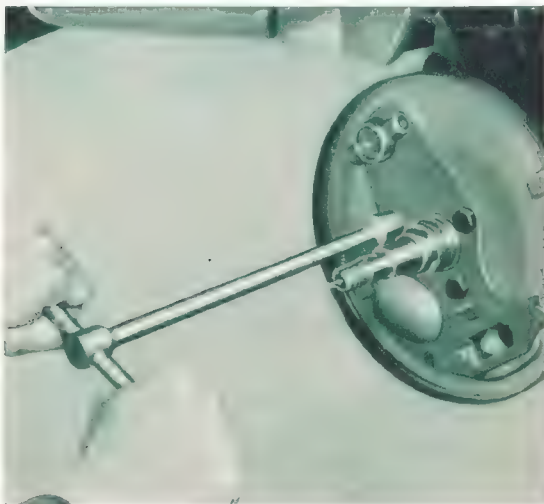
- 3 - Secure the bolts by means of a piece of wire so as to insure that they do not work loose.

- 4 - Before installing brake drum, make sure the oil seal is in perfect condition.

- 5 - Clean grease cup, brake drum hub and ball bearing and apply Universal Grease VW — A 052.

- 6 - Adjust front wheel bearing as prescribed in the section “Front Axle”.

- 7 - Adjust the brakes.

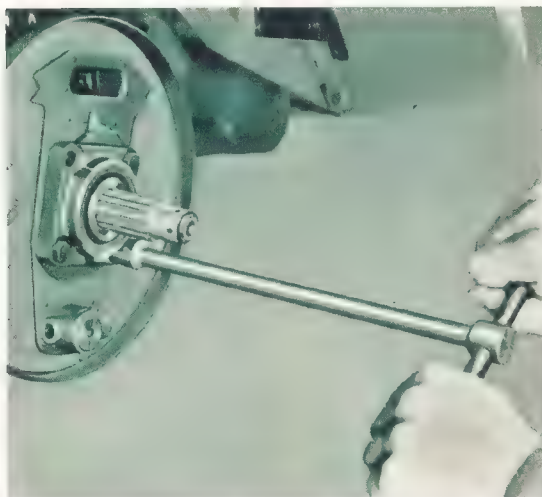




## Removing and Installing Rear Brake Back Plates

### Removal

- 1 - Raise the car.
- 2 - Remove rear wheel.
- 3 - Remove brake drum.
- 4 - Remove expander and operating link.
- 5 - Withdraw brake cable from back plate.
- 6 - Remove cotter pin and brake shoe leaf spring.
- 7 - Remove brake shoes and return springs.
- 8 - Take off locating pins.
- 9 - Remove the four screws at rear axle shaft bearing housing and take off housing cover.



- 10 - Remove brake back plate.

### Installation

This is a reversal of the above operations, but it is important to observe the following points:

- 1 - Grease cable adjusting sleeve and lock nut as well as adjusting screw and cone. Make sure that these parts freely move. If necessary, renew cotter pin for adjusting cone.
- 2 - Prior to refitting the bearing housing cover, check if the oil seal rests squarely in the cover and if it is in a perfect condition. Renew damaged gaskets. The oil drip nose of the cover must point downward.  
  
Tighten the four bolts to the following torques:  
Bolts of quality specification 8 G  
to 4—4.5 mkg (29—32 ft. lbs.).
- 3 - When installing brake drum, note correct position of oil deflector.
- 4 - Tighten rear axle shaft nut to a torque of 28—31 mkg (202—224 ft. lbs.) and secure it with a cotter pin.
- 5 - Adjust the brakes.

## Basic Adjustment

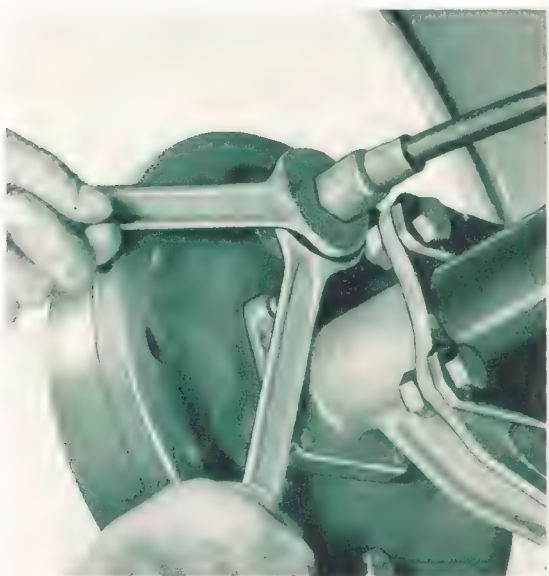
- 1 - Lift the car and release hand brake.
- 2 - Check clearance between hand brake push bar and foot brake push bar (approx. 1 mm/0.04") at hand brake lever. If necessary, adjust hand brake push bar.
- 3 - Eliminate free movement of brake pedal by correcting the position of the stop plate.
- 5 - Turn adjusting sleeve and lock nut clockwise, that is, toward the brake back plate.
- 6 - Tighten brake shoe adjusting screw until the brake drum no longer can be turned by hand. If the wheel has just been installed, turn adjusting screw until a heavy drag is felt.



- 4 - Release adjusting sleeve lock nut at the back plate.



- 7 - Turn adjusting sleeve until there is very little clearance between the end piece of the cable hose and the adjusting sleeve.



- 8 - Tighten adjusting sleeve locknut.

- 9 - Loosen the brake shoe adjusting screw until the brake drum can just be turned freely. A light tap against the screw will place the brake shoes and the adjuster cone in the correct position.
- 10 - Repeat operation 4 to 9 on the other wheels.
- 11 - Pull up the hand brake by three notches and check equal braking effect on all four wheels. In case there is a difference in the braking effect among the four wheels, release the hand brake and loosen the brake shoe adjusting screw on the wheel with the highest braking resistance. At the fourth notch it should be impossible to turn the wheels by hand.
- 12 - Lower the car and make a road test to assure proper brake operation.

**Note. —**

If, after a long period of service, the cable can no longer be correctly adjusted due to an excessive lengthening, a distance piece should be installed.

**Re-Adjustment**

- 1 - Lift the car and release hand brake.
- 2 - Tighten brake shoe adjusting screws of all four wheels until the brake drums can still be turned freely.
- 3 - Pull up the hand brake by three notches and check equal braking effect on all four wheels. In case there is a difference in the braking effect among the four wheels, release the hand brake and loosen the brake shoe adjusting screw on the wheel with the highest braking resistance. At the fourth notch it should be impossible to turn the wheels by hand.
- 4 - Lower the car and make a road test to assure proper brake operation.



## Treatment of Mechanical Brake When Cold Season Begins

### General

In winter, the brakes are especially exposed to splashing water that is apt to freeze in the brake drums and conduit tubes. At the beginning of the cold season, the conduit tubes of the brake cables should, therefore, be thoroughly lubricated with anti-freeze lubrication grease. Do not use just any lubricant, but only the anti-freeze, water-repellent Grease VW — A 052.

### Operations

#### Brake Cables

- 1 - Remove frame head cover.
- 2 - Remove cover plate on brake cable junction head.
- 3 - Unhook brake cables.
- 4 - Withdraw foot brake push bar.
- 5 - Completely fill the conduit tubes with grease without removing the cables.

#### Note. —

The firm Tecalemit has designed a Conduit Tube Filler 200120 consisting of a conjunction piece and an operating lever.

- 6 - Fill brake cable hoses with grease. Remove the end of each hose from the adjusting sleeve for a check.

The assembly is a reversal of the above operations.



#### Wheel Brakes

- 1 - Remove brake drums and check them for wear and scores.
- 2 - Clean brake back plate and control linkage.
- 3 - Check brake linings. In case of excessive wear, remove linings on all four wheels.
- 4 - Grease all moving joints.
- 5 - Reinstall brake drum.
- 6 - Adjust brakes.

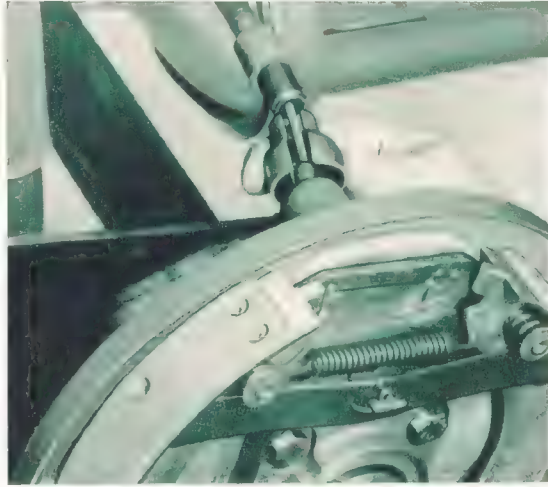
## Installing Distance Piece for Lengthened Brake Cables

If it is found that the lengthening of a brake cable can be no longer compensated by turning the adjusting sleeve, a distance piece is to be installed between the brake hose end piece and the adjusting sleeve.

### Operations

- 1 - Remove brake drum.
- 2 - Remove expander and operating link.
- 3 - Withdraw brake hose from adjusting sleeve.
- 4 - Install distance piece.

Assembly is accomplished by reversing the above operations.



## General

Drop-center rim type wheels are used on the Volkswagen.

The rim size is: 4 J x 15  
The tire size is: 5.60 — 15

Proper wheel and tire maintenance is essential to economical and safe automobile operation.

The maintenance includes:

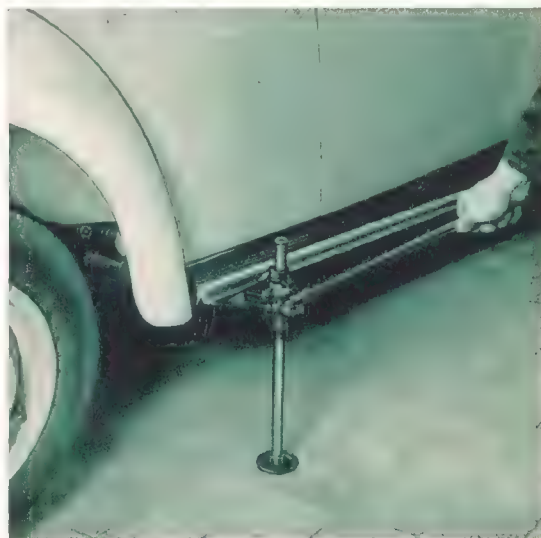
- 1 - Properly tightened wheel mounting bolts.
- 2 - Maintaining correct tire pressures.
- 3 - Inspecting tires for damage and signs of wear.
- 4 - Periodical tire rotation (criss-crossing).
- 5 - Wheel balancing.



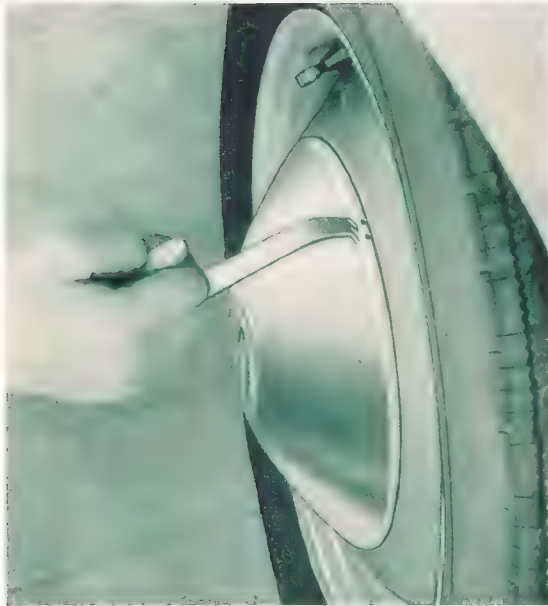
## Wheel Removal and Installation

### Removal

- 1 - Set the hand brake.
- 2 - Insert jack into the square tube below the sill panel. The jack should stand on solid ground.
- 3 - Remove the hub cap by means of the cap removing tool VW 370 (drawing for local manufacture) or a similar tool.







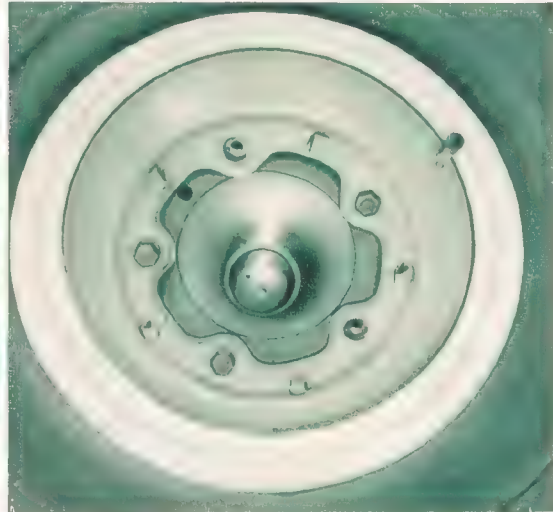
- 4 - Loosen wheel bolts by means of the hex. socket wrench.
- 5 - Jack up the car.
- 6 - Remove wheel mounting bolts and take off wheel.

#### Installation

Installation takes place in the reverse order to the

instructions on removal, but the following points should be watched closely:

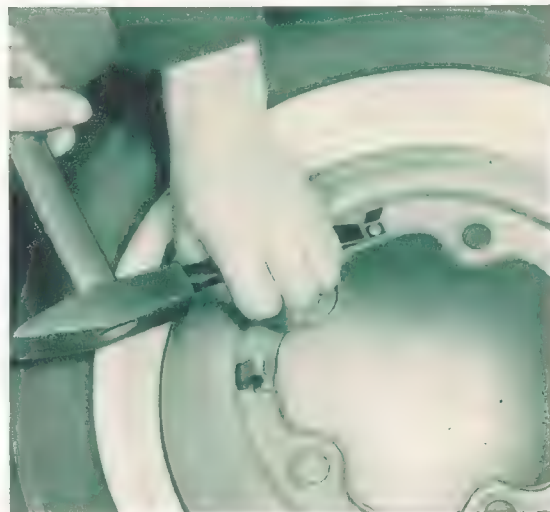
- 1 - Screw in the wheel mounting bolts until the countersunk heads rest centrally in the corresponding recesses.



- 2 - Lower the car.
- 3 - Tighten all bolts diametrically opposite in turn to a torque of between 9 and 11 mkg (65 and 80 ft. lbs.). Oversize bolts M 14 are to be tightened to between 11 and 13 mkg (80 and 94 ft. lbs.).

## Replacing Broken Hup Cap Retaining Springs

- 1 - Remove wheel.
- 2 - Remove broken spring and rivet, using a flat chisel. Drive out the remaining piece of the rivet.
- 3 - Clamp the dolly in a vise and position a button-head rivet (4.5 x 7 mm) and the retaining clip as shown in the next illustration.





4 - Place wheel horizontally (outside down) over the dolly so that rivet enters the corresponding hole in the wheel.

5 - Set the retaining spring in place.



6 - Paint retaining spring and rivet on both sides.

7 - Position the wheel and tighten the mounting bolts.

## Damaged Wheels

Slightly damaged rims, especially rim flanges, can be repaired without difficulty. If more severe damage is present, e. g. after accident, the serviceability of the wheels should depend on the result of a test for run-out (maximum permissible lateral and

radial run-out being 1.5 mm/0.06"). In any case, the wheel assembly must be balanced both statically and dynamically on an accredited wheel balancer after a repair has been carried out. Distorted wheels should be discarded.

## General

The condition of the tires has an essential bearing on economical and safe automobile operation. If a wheel and tire assembly is out of balance, the car will be hard to steer, riding will be rough, and tire wear will be rapid.

Maximum tire mileage can be gained by periodical care and maintenance under normal operating conditions. It should also be made clear to the owner that neglect or indifference is costly and that the small amount of time spent in giving attention to the tires is well repaid.

Undue tire wear may be attributable to incorrect tire pressures, unreasonable driving habits, and bad road conditions.

The tires should not be exposed to intense sunshine, fuel, and oil.

Following are the tire specifications:

Tire size: 5.60—15

Dimensions:

Outer diameter	653 mm (25.7")
Width	145 mm ( 5.7")

Statically effective radius	304 mm (11.9")
Dynamically effective radius	307 mm (12" )

### Tire Pressures

1 to 2 occupants

front:	1.1 atm. (16 lbs./sq. in.)
rear:	1.4 atm. (20 lbs./sq. in.)

3 to 4 occupants

front:	1.2 atm. (17 lbs./sq.in.)
rear:	1.6 atm. (28 lbs./sq.in.)

## Tire Removal and Replacement

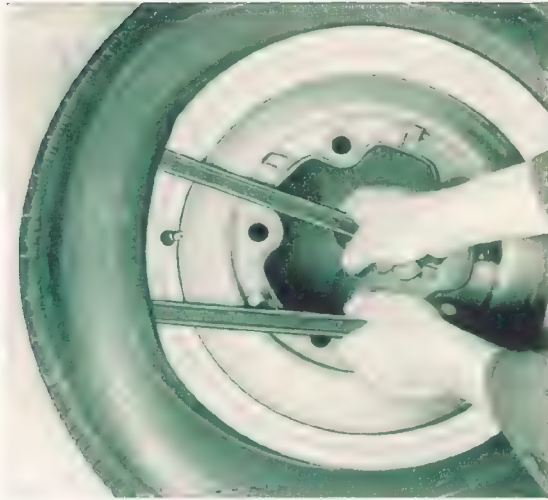
The tire should be removed from the wheel rim carefully in order to avoid damage. Damaged beads and an incorrect position of the tire in the rim are frequently responsible for premature wear and rear. Particular attention should be paid to the proper seating of the tire in the rim.

### Removal

- 1 - Screw off valve cap and valve core.
- 2 - Lay the wheel on the floor outside up and break loose the tire bead from wheel rim flange.
- 3 - Force the bead into the rim well at the point opposite to the valve stem and pry the tire bead over the rim flange by means of tire irons, starting at the valve stem.







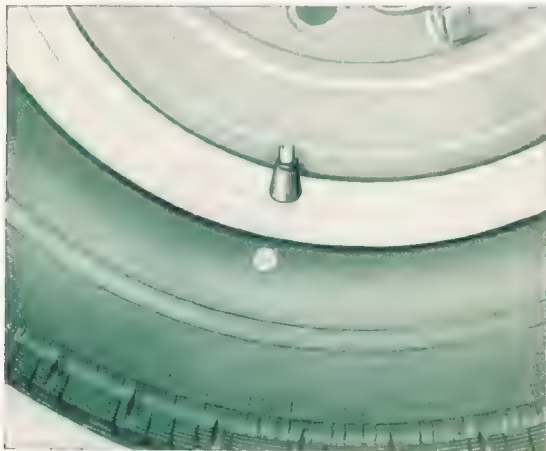
4 - Remove the tire tube.

5 - Examine valve and tube for leaks and mark the points of leaks. Check tube for signs of excessive friction. The tire casing should be carefully checked for cracks, cuts and bruises inside and out. Flints and stones that are embedded in the tire should be removed and the holes filled with suitable compound. Also remove all traces of grease and oil.

#### Tire Replacement

Installation of the tire is accomplished by reversing the removal procedure, but the following points should be observed:

- 1 - Lightly coat the inside of the tire case with talc powder.
- 2 - Be sure not to damage the tire beads when replacing the tire.
- 3 - Place the dry tube into the tire case so that the red dot on the tire is in line with the valve stem.



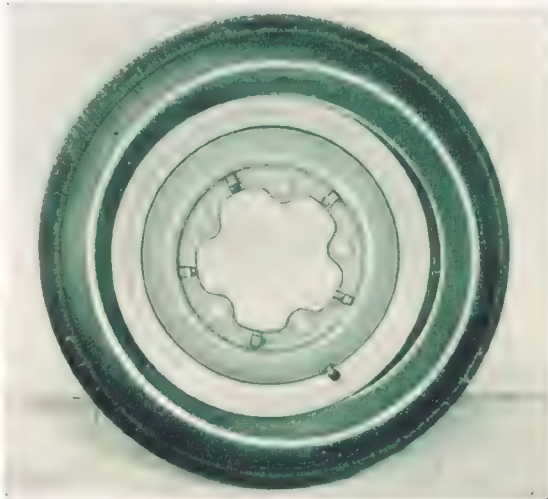
If the tires are marked by two dots, the valve stem must be located between them.

4 - Inflate the tube slightly to shape it to the tire.

5 - Before inflating the tube, be sure that the beads are out of the well and properly seated against the flange to avoid pinching the tube.



correct installation



wrong installation

6 - Do not forget to reinstall the valve cap.

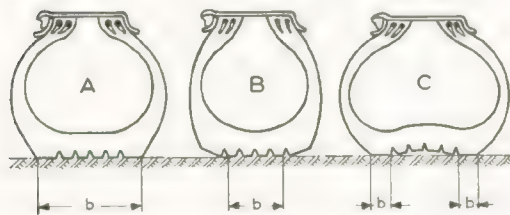
7 - Inflate the tube to the specified pressure.

## Tire Inspection

The tires should be frequently checked for correct inflation and undue signs of wear as well as for cracks, grease, cuts, and bruises. Flints and stones that are embedded in the tire should be removed.

### Tire inflation

Correct inflation is one of the most important factors for long tire life and perfect riding qualities of the VW Passenger Car. Tires in ordinary use should be checked at least once each week with an accredited tire gauge. An intermingling of the oxygen with the tire tube accounts for a slight drop in the pressure after some time of operation.



A = Proper inflation  
B = Overinflation  
C = Underinflation  
b = Road contact

Tire pressure should be checked only when tires are cold, that is before operation. Tire pressures vary with temperature, the pressure increases when tires are hot. The tires and tubes are constructed with allowances for pressure buildup by expansion resulting from operation at high speeds and hot pavement.

### Note: —

Care should be taken when using a simple tire gauge for a prolonged period. After a certain time of use, such tire gauges are subject to variations. Although the readings obtained often depart only slightly from the real pressure in the tube, the detrimental over

or underinflation may lead to abnormal tire wear. Therefore, it is absolutely necessary to regularly check the tire gauge for accurateness.

The tightness of the valve cores can easily be checked by moistening a finger and placing it on the valve opening. Renew leaky valve cores.

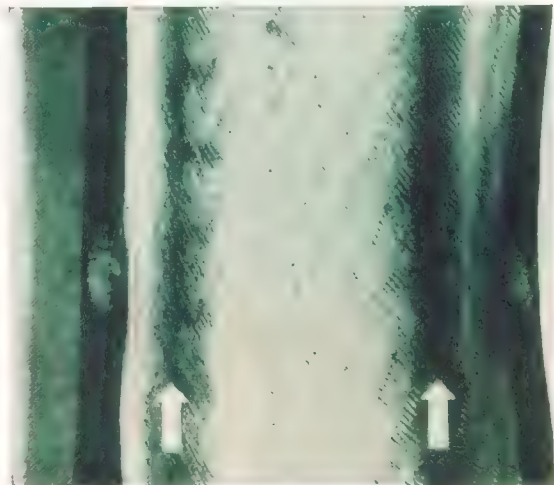
### Abnormal tire wear

Following are the causes for abnormal tire wear:

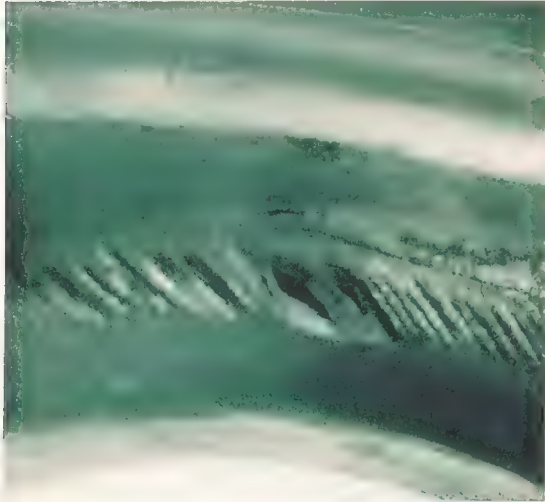
- Underinflation or overinflation
- Poor driving habits
- Overloading the vehicle
- Bad road conditions
- Improper wheel adjustments

### Underinflation

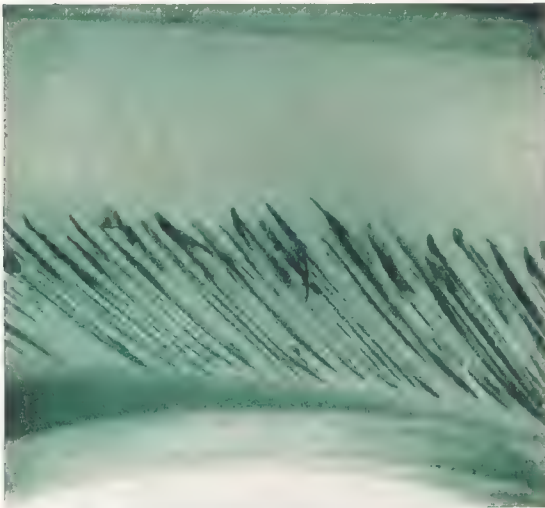
An underinflated tire will be subjected to excessive flexing of the side walls and resultant heat. Underinflation can be determined by wear at the sides of the tread. Two black stripes will first form inside



the tire casing, leading to damage of the fabric structure. If the tires are further operated with



Insufficient air pressure, the plies in the side walls will separate so that the tires are ruined.



The underinflated tire contacts the road along the sides, where the tread is subjected to greater wear than the center.

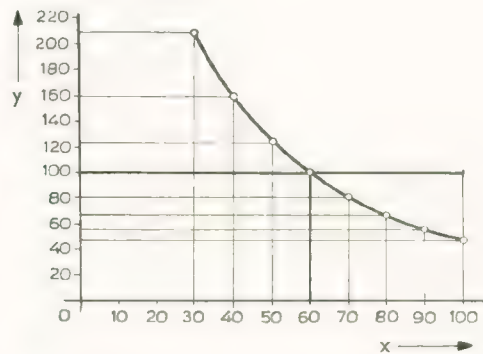


### Overinflation

Overinflated tires cannot absorb road shocks and abnormal wear will occur at the center of the tread, making the tires susceptible to bruises and breaks.

### Driving habit

The average speed of automotive vehicles has gone up considerably in the course of the past decade. The tire wear increases rapidly with the speed. The chart indicates how much more rapidly tires wear at high than at low speed.



Influence of speed on tire life

$x$  = Speed (km)

$y$  = Relative tire life

The average value for tire life is indicated at the speed of 60 km p. h. = 100 per cent on the chart.



High-speed operation causes much more rapid tire wear because of the high temperature and greater amount of scuffing and rapid flexing to which the tires are subjected. Fast acceleration, sudden severe brake application, turning corners and rounding curves too fast or sharply will additionally contribute to increased and uneven tire wear.

loading, however, has a detrimental effect on the tire structure.

This wear results in a saw-tooth effect with one end of each tread block worn more than the other.

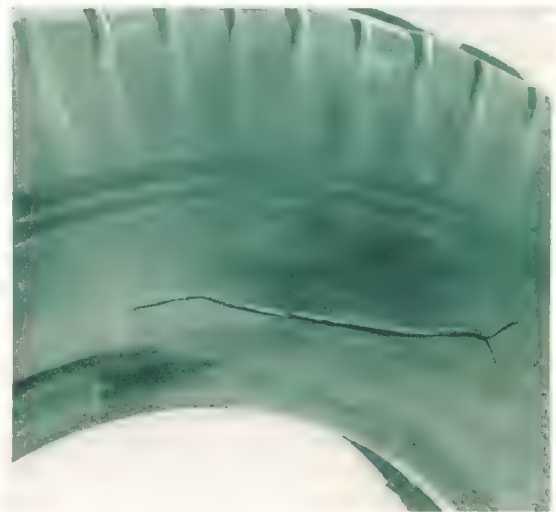


The reasons for increased tire wear when applying the brakes are clear, but it should be borne in mind that unequally or improperly adjusted brakes or differences in the quality of the brake shoe linings may lead to abnormal wear of some tires. Eccentric brake drums may also be the cause for unequal tire wear.

With the tire continuously overloaded, the fabric structure inside the tire will crack. After some time of operation, the cracks appear outside in the tire walls.

#### Overloading the car

Tires interpose a cushion between the road and the car wheels. The compressibility of the air in the tube allows the tires to absorb shocks resulting from irregularities in the road. It is the interrelation of air pressure, air volume and load that determines the correct tire size. Each tire size has to cope with a certain continuous load at a given inflation pressure. A temporary overloading is common in the operation of a motor vehicle; a fact which has been taken into account in designing the tires. Continuous over-



### Road Surface

The tire life largely depends on the condition of the surface. To contribute to safe driving, antiskid material is now used to cover the roads. This provides frictional contact between the wheels and the road so that good traction is secured. This will make the tires subject to increased wear.

On steeply cambered roads (high crowned roads), the tires have to resist a side force which the driver attempts to compensate by applying a certain force on the steering wheel toward the center of the road so that the tires drag at an angle to the direction of vehicle movement.

Even a slight departure from the correct toe-in adjustment is very detrimental to the tire life under such conditions. If the toe-in is excessive, the tire toward the nearer curbstone wears more rapidly. If the toe-in adjustment is too low, the wheel toward the center of the road wears faster. This wear is usually distinguished by side wear and feather edges of rubber that appear on one side of the tread design.

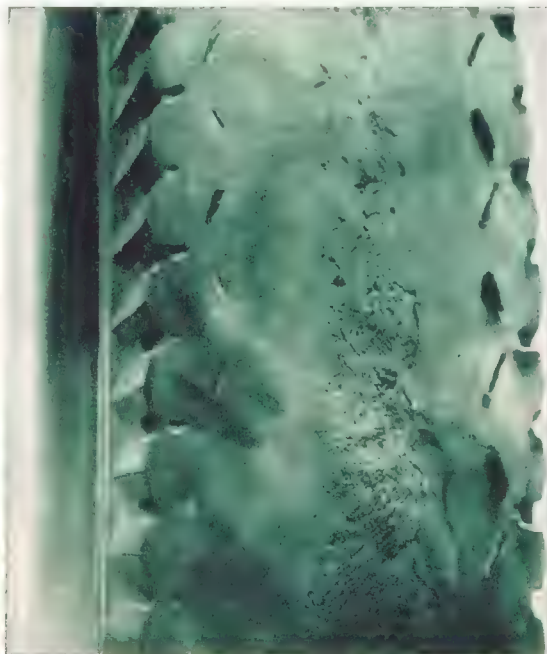


A faster wear on steeply cambered (high crowned) roads must be taken into consideration, even if the toe-in adjustment is correct, but such wear will not be confined to one tire.

### Misaligned Wheels

There are also several types of wear which can be attributed to wheel misalignment. In each case of abnormal tire wear, it is strongly recommended to check the adjustments of front axle and steering. When only the rear tires are concerned, the spring plate adjustment and the efficiency of the shock absorbers should be checked.

Misaligned wheels cause part of the tread rubber to be scraped off; this is indicated by feather edging of the tread and side wear.



Uneven tire wear is also generally due to mechanical troubles.

A chassis that has been involved in an accident should in all cases be checked for proper alignment to assure a perfect track of the wheels.

### Grease, Foreign Matter, and Cuts

Grease or oil soaked dirt should be removed from the tire tread and the spots cleaned by means of fuel. Never use paraffin.

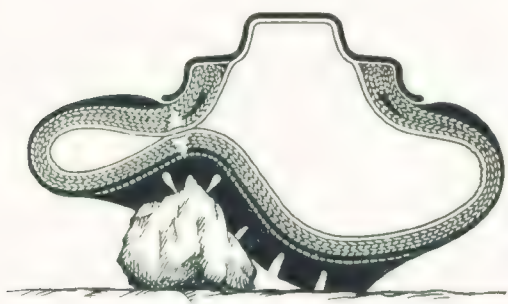


Foreign matter embedded in the tire should be removed as soon as possible. Small damage to the tread material is of minor importance. More severe damage to the tread material or even to the tire casing should be eliminated by vulcanizing to avoid the tire becoming completely ruined by ingress of moisture.

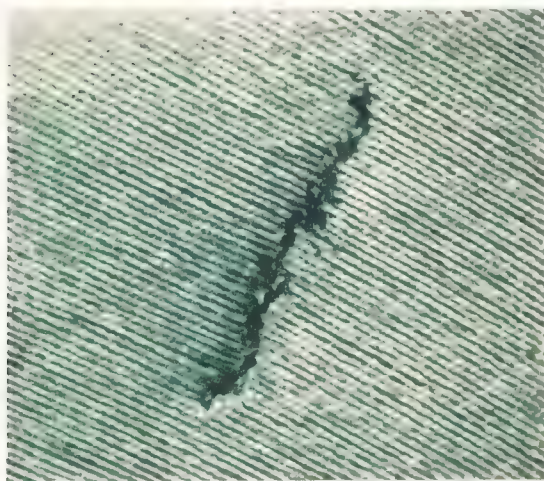
After the flints, nails, etc., have been removed from the tire, it is good practice to fill up the holes with suitable compound.

### Cracks and Breaks

Sudden and violent shocks resulting from stones or gutters, etc., may cause cracks or breaks in the fabric structure of the tire casing. The illustration below indicates how such damage occurs.



The damage so caused may be of various natures:



Single diagonal break



Double thrust break

This kind of damage is generally difficult to locate outside. It is, therefore, absolutely necessary to carry out a thorough inspection at the inside of the tire when removing the tube for repair. Cracks or breaks in the tire casing cause excessive friction between the tire and the tube at the point of damage,



resulting in damage to the tube. It is often the case that only some of the plies are broken and that the damage expands when the trouble had not been located within a reasonable time.

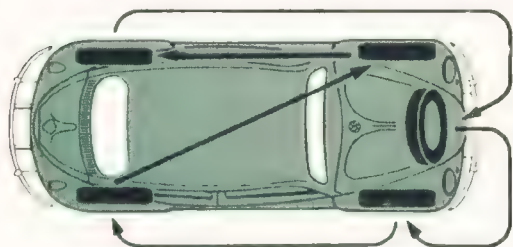


## Service Diagnosis of Abnormal Tire Wear

Type of Wear	Cause
Wear at the sides of the tread.	Underinflation.
Wear at the center of the tread.	Overinflation.
Spotty or irregular wear (gouges and waves).	Wheel assembly static and dynamic unbalance. Lateral wheel run-out. Excessive play in wheel bearings or at king pin.
Lightly worn spots at the center of the tread (cups).	Wheel and tire static unbalance. Radial wheel run-out.
Flat spots at the center of the tread.	Violent brake application. Brake drum out of round. Check brakes!
Heel and toe wear (saw-tooth effect with one end of each tread block worn more than the other) leading to cracks in the fabric structure which become visible outside in the long run.	Typical for overloading. Check inside of tire casing for cracks.
(a) Side wear. (b) Feather edge of rubber on one side of the tread blocks. (c) Rounding and roughening of the tread at the outside shoulder of the tire.	(a) Incorrect camber. Continual driving on steeply cambered (high-crowned) roads. (b) Wheels toe-in or toe-out excessively. If the rear wheels are concerned, check adjustment of spring plate and effect of shock absorbers. (c) Caused by high speed driving on curves, called cornering wear.

## Tire Rotation

To equalize wear of all tires it is recommended to rotate the wheels periodically at intervals of some thousand miles. The spare wheel should be included in the rotation in order to obtain additional tire mileage. The tires should be rotated as shown below.

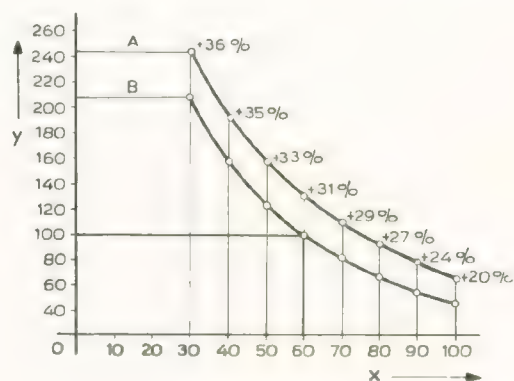


Not only is there a difference in the amount and type of wear between front and rear position, but also between the left and right side of the car, as the turning direction of the wheel is reversed by the above rotation.

As a precautionary measure, you should employ the better tires on the front axle, if already unevenly worn.

### New Tires

It is good practice to renew the tires in autumn as tire wear is generally higher in summer than in the cold season. At the same time it should be taken into consideration that the treads of the new tires provide good traction during the cold season when bad road condition such as snow, ice and thaw prevail.



Seasonal influence on tire life (outer temperature)

A = Winter    B = Summer

x = Speed of car (km)

y = Relative tire life

## Wheel and Tire Balancing

The wheel and tire assembly balance must be maintained to insure good riding qualities and best steering performance of the car. A statically unbalanced condition of a wheel and tire assembly is indicated by an up and down hopping or pounding action. The wheel wobbles or shimmies if it is dynamically out of balance. The faster a car the more important is a perfect wheel and tire balancing.

Wheel balance is the first item to check after the tire has been repaired, retreaded or recapped. Should it not be possible to have repaired tires balanced both statically and dynamically, the car owner should be advised to use such wheels on the rear axle only and to drive at moderate speed. Any unbalanced condition may be destructive and dangerous, reducing not only the life of tires, but also the life of other vital parts of the car.



A

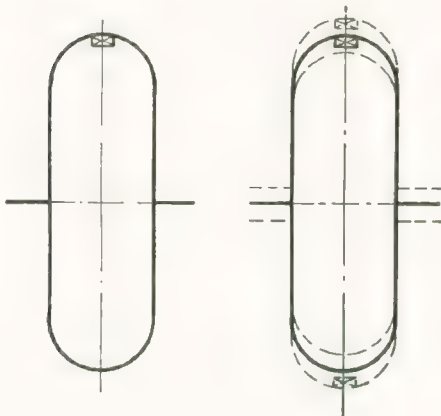
B

#### Influence of unbalance on tire wear

A = Balanced wheel and tire after 14,200 km

B = Unbalanced wheel and tire after 11,500 km

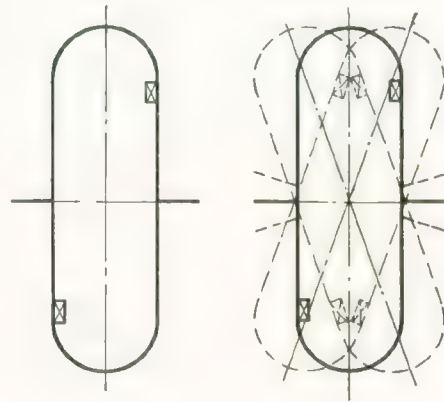
Wheel balance is the equal distribution of the weight of the wheel, tire and tube, brake drum and hub around the axis of rotation. The complete wheel assembly should be balanced both statically and dynamically.



A wheel assembly may be considered in static balance when it will remain static in any position to which it is revolved on its axis.

A wheel which is not statically balanced causes the tire to bounce at each revolution. The effect of the static unbalance increases with the speed of the car.

Perfect static balance does not assure that the wheel assembly is in complete balance. A dynamically out-of-balance wheel does not have even weight distribution in a plane vertical to the wheel axle.



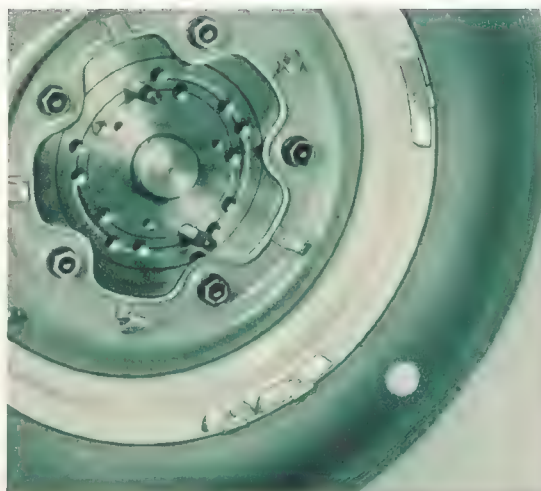
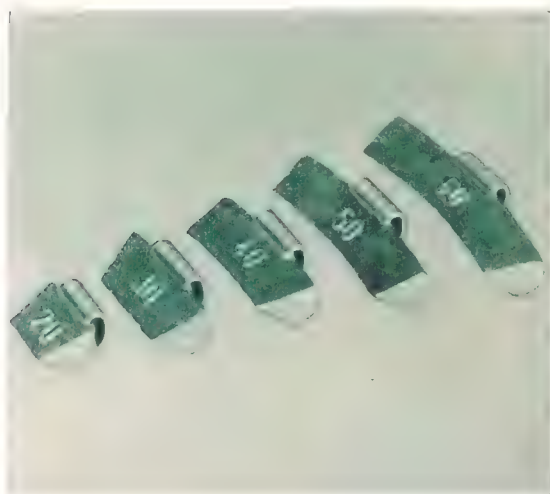
Dynamic unbalance causes the wheels to vibrate rapidly from side to side in their effort to revolve in a straight vertical plane. The greater the speed the more pronounced the condition becomes and steering ability is affected accordingly. This produces excessive wear of the tires, wheel bearings, king pins and steering connections. Prior to balancing the wheel and tire assembly, the wheel rim should be checked for lateral and radial run-out (maximum permissible: 1.5 mm/0.06").

Static balancing can be carried out on a locally-made balancing fixture. Dynamic balancing requires special equipment to determine the value and location of weights in order to correct the condition without disturbing the static balance. Several types of wheel balancer are in use, all operating in a similar manner. The wheel balancer should be used as instructed by the manufacturer.

Some types of wheel balancer have been tried at the VW Service Department to which reference should be made when further information is required.



The weights used to correct the balance are of lead and are available in various sizes.



**Note. —**

Tires are factory balanced to compensate for the weight of the valve stem in the tube, and alignment of the dot, or two dots, on the tire and the valve stem will assure this balance.

### Static Balancing

- 1 - Attach the wheel to the wheel balancer, using the five wheel mounting bolts. The wheel assembly should be in a clean condition.
- 2 - Move the wheel assembly and allow it to turn until it stops. The heaviest part comes to rest at the bottom. Mark the rim flange at the point diametrically opposite to the heavy point by means of a piece of chalk.
- 3 - Attach a suitable weight to the rim at the point marked with chalk.
- 4 - The wheel assembly may be considered in static balance when it does not rotate from any position in which it is stopped.
- 5 - Clamp the weight securely in place.

### Dynamic Balancing

The wheel assembly must be balanced statically before testing and balancing to obtain proper dynamic balance. Static balancing eliminates up-and-down movement of the wheels (wheel tramp), while dynamic balancing is to counteract the tendency of the wheel to wobble due to a heavy spot on one side of the wheel when it is rotated.

- 1 - Attach the wheel to the wheel balancer, using the five wheel mounting bolts. The wheel assembly should be in a clean condition.
- 2 - Let the wheel spin at high speed.
- 3 - Determine the sizes of the weights.
- 4 - Determine the points on both sides of the rim at which the weights must be attached. Attach the weights.
- 5 - Recheck the static balance.

An unbalance up to 30 grams (1 oz.) has no bearing on the operation of the wheel.

**Installed on:** Karmann-Ghia Coupé from Chassis No. 1239921  
 VW Convertible from Chassis No. 1245207  
 VW Sedan from Chassis No. 1248028

## General

Tubeless tires can be changed by simple means. Required are two long tire irons with carefully rounded off edges, a valve installing tool and a bead breaker to break loose the tire bead from its seat in the rim.

Details can be obtained from the Technical Service Department of the Volkswagenwerk.

Whenever working on tubeless tires it is of paramount importance to make sure that the air retaining and sealing lining does not suffer damage.

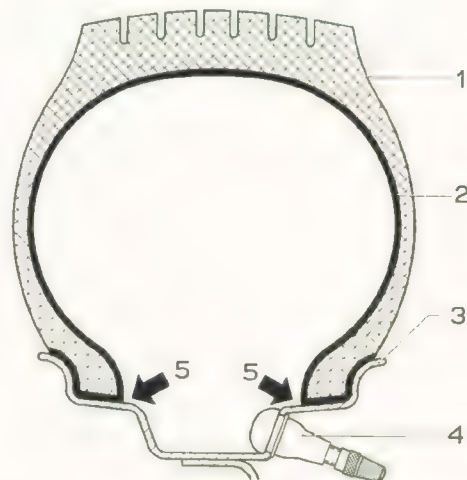


A - Tire Irons  
 B - Valve Installing Tool VW 639  
 C - Bead Breaker VW 640

### Note:

Full details about the tools VW 639 and VW 640 will soon be given in the 4th supplement to the manual "Local Manufacture of Workshop Equipment".

Apart from these tools, there are a number of tire tool sets from various manufacturers that have been tested for their suitability for the Volkswagen.



1 - Tubeless tire  
 2 - Air retaining and sealing lining  
 3 - Rim flange  
 4 - Valve  
 5 - Rim sealing surface

The following instructions should be heeded in changing tubeless tires.

## Tubeless Tires on New Type Wheels 4 J x 15

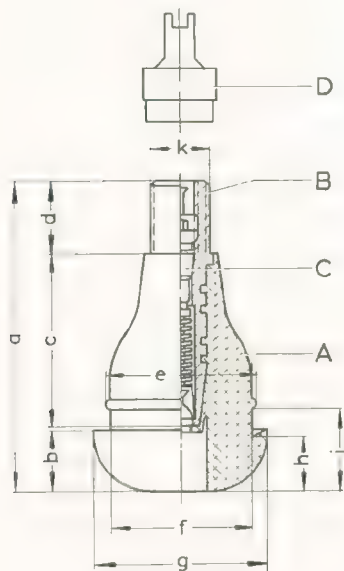
(Part No. 111 601 025 c)

The new type wheels 4 J x 15 have a rectangular recess at the hole for the valve. Stamped between

two wheel fixing holes is a "T" for further identification.



A rubber base valve (Part No. N 201011) is used as standard equipment for tubeless tires.



A - Rubber base  
B - Valve stem  
C - Valve core  
D - Valve cap

a = 43.0 mm (1.69")	f = 19.5 mm $\varnothing$ (0.77")
b = 8.5 mm (0.33")	g = 23.5 mm $\varnothing$ (0.93")
c = 24.0 mm (0.94")	h = 7.5 mm (0.29")
d = 10.0 mm (0.39")	i = 11.5 mm (0.45")
e = 20.5 mm $\varnothing$ (0.81")	k = Valve thread 8

## Dismounting Tire

- 1 - Screw off valve cap and valve core.
- 2 - Break the tire bead loose from its seat in the rim. This is best accomplished with the Bead Breaker VW 640.



- 3 - Using tire irons, pry the bead over the edge of the rim.

### Caution!

To guard against damaging the sealing lining on the bead, only use long tire irons having carefully rounded off edges.

- 4 - Check the air-retaining and sealing lining inside the tire for damage and bruises. Inspect the exterior of the tire for embedded flints and stones, cuts, grease, and for signs of wear.
- 5 - Check valve rubber base for cracks and breakage.



## Mounting the Tire

Mounting tubeless tires is, in general, accomplished by reversing the dismounting procedure.

- 1 - Check the rim for damage. Never mount tubeless tires on rims having damaged, distorted or deeply scratched shoulders or flanges.

- 2 - Remove any dirt from rim shoulders and flanges, use a wire brush, if necessary.

- 3 - Pull the rubber base valve (Part No. N 202011) into position, using the Valve Installing Tool VW 639.



- 4 - Mount tire on the rim with the red dot on the sidewall of the tire located at the valve. Be careful not to damage the tire beads.
- 5 - Remove the valve core.
- 6 - Allow the full rush of air to overinflate the tire to 3 kg/cm<sup>2</sup> (42.67 lbs./sq. in.). This initial rush of air will push the tire beads against the rim flange and provide a quick seal.

### Note:

If the sidewalls of the tubeless tires are pressed together because of improper storing, a bead ex-

pander (a spring steel band placed round the circumference of the uninflated tire) should be applied to spring the beads against the rim flange for proper sealing.

Tubeless tires should always be stored in an upright position.

- 7 - Screw in the valve core and deflate the tire to the correct pressure.

### Caution!

The tire pressures prescribed for the conventional tubes and tires on VW Passenger Cars also apply to tubeless tires.

- 8 - Check air seal of tire and valve by immersing in a water tank.

### Caution!

All tubeless tires are uniformly inflated to 1.6 kg/cm<sup>2</sup> (23 lbs./sq. in.) at the factory. Be sure they are brought to the specified pressures before delivery of the car.

### Note:

Occasional complaints about tubeless tires would suggest that little attention is paid to the installation procedure. In order to insure safe operating conditions it is of great importance to observe the hints given.

Proper tire fit and tight seal are assured only if the following points are heeded:

- a - Rim must be free from dirt and rust.
- b - Rim must be airtight.
- c - Rim shoulder and flange must not be damaged.
- d - Tire air retaining and sealing lining must not be damaged.
- e - Valve must be properly fitted in rim hole. Rubber base must not be damaged (breaks, cracks).
- f - Overinflate tire to 4 kg/cm<sup>2</sup> (57 lbs./sq. in.) with the full rush of compressed air with valve core removed.
- g - Check inflated tire and valve for leaks in water bath.

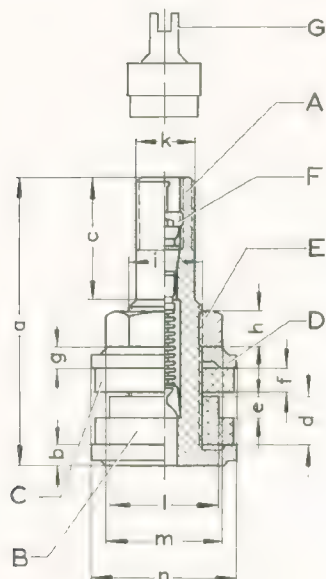
For installation of tubeless tires use tools recommended in the Workshop Manual.

If, at regular tire checks, excessive loss of pressure is apparent (more than 20—25% of the specified pressures) check for leaks in tire, rim and valve.

## Mounting Tubeless Tires on 15" Wheels of the Earlier Version

(Part No. 111601021 c)

Mounting tubeless tires on old type 15" wheels is possible by using a valve of the Part No. N 201021.



A - Valve stem  
B - Inner seal  
C - Outer seal  
D - Thrust washer  
E - Nut  
F - Valve core  
G - Valve cap

a = 40.0 mm (1.57")	h = 5.0 mm (0.20")
b = 3.5 mm (0.14")	i = Valve thread 10
c = 17.0 mm (0.67")	k = Valve thread 8
d = 7.0 mm (0.28")	l = 15.0 mm $\varnothing$ (0.59")
e = 3.0 mm (0.12")	m = 14.0 mm (0.55")
f = 4.0 mm (0.16")	across flats
g = 3.0 mm (0.12")	-n = 20.0 mm $\varnothing$ (0.79")

Mounting the tire is accomplished by following the procedure given on the previous page, but the following points should be noted:

- 1 - Remove dirt, rust, and paint sags from rim. Using the wire brush, clean rim shoulder and flange.

Never mount tubeless tires on rims having damaged, distorted or deeply scratched shoulders or flanges.

- 2 - According to the type of the rim, a further check should be carried out as follows:

- a - Welded rim: Carefully smooth down the welded joint.
- b - Riveted rim: Check rivets for looseness and porosity. If necessary, leaks should be remedied by peening over the rivet head with a hammer. Rims with leaky rivets are unsuitable for tubeless tires.

- 3 - The valve of the Part No. N 201021 should be used whenever mounting tubeless tires on earlier type wheels.



The now standard rubber base valves do not insure a perfect seal in earlier type rims.

- 4 - Insert the valve with inner seal in the rim and slide the outer seal and thrust washer onto the valve stem so that the larger face of the washer contacts the seal.

- 5 - Tighten the nut.

- 6 - As to the further procedure refer to "Mounting the Tire" from point 4- onwards.



### Bearing of Weather Conditions on Tire Life

Among the factors which determine the tire mileage are also the weather conditions.

Heat is the worst enemy of the tire. Under the influence of high outside temperatures, the operating temperature of the tire increases rapidly — especially during a long non-stop ride — so that the structure of the tire is liable to change. Such alteration in the structure of the tire causes abnormal wear if the tire is continually subjected to an excessively high thermal load.

Therefore, it is recommended to pay attention to the heat development of the tires on long trips at high speed when high outside temperature prevails. It pays off to stop from time to time and let the tires cool down in the shade. Tire pressures vary with temperature and the pressure increases when tires are hot. That is why the pressure should be checked only when tires are cold, that is before operation.

Tire wear is less when the road surface is wet, as the water acts as a lubricant, reducing the frictional contact.

### Anti-Skid Qualities of Tires

#### General

A wet or ice-covered road surface reduces the frictional contact between the wheels and the road, but this condition will also reduce the traction of the car. The tendency of the car to skid is influenced by

- a - Road surface materials
- b - Weather and season
- c - Tire tread

#### Road Surface Materials

Concrete roads, granite paving stones, or asphalt containing basalt chippings combat the tendency of the car to skid in wet weather. Unfluted asphalt roads are especially slippery and dangerous. Care should also be taken when driving on wet basalt or wood block pavements. Basalt can be recognized by its dark-blue colour.

#### Weather and Season

Drizzle, fog or sleet increase the tendency of the car to skid. Wet leaves, soil dropped by agricultural vehicles as well as snow and ice render roads dangerous. Continuous rain, however, will wash off the greasy film from the surface.

#### Tire Tread

The tire tread design is of great importance to the steering stability of the car under bad road and weather conditions. Where the tread has worn smooth, it is sometimes possible to retread the tire in order to restore the traction and anti-skid properties.



## New Marking

Since October 1952, all VW Passenger Cars were fitted with standard tires 5.60—15 with inner tubes but as of the middle of July 1956 we have been using exclusively tubeless tires of the same size. On the outer side wall these tires are marked "Tubeless" or "Schlauchlos".

To permit easier identification of the two tire types, all standard tires 5.60—15 with inner tubes have been given a new marking. As of February 1958, they will be marked with a green dot instead of the red dot that used to indicate the thinnest spot of the outer tire where the valve is supposed to be during mounting. All tubeless tires continue to carry the red dot.

Consequently, tires marked with green dots must always be mounted with inner tubes.

During a transition period, standard tires 5.60—15 with inner tubes marked with either red or green dots will be stored together with the tubeless tires marked with red dots and we should, therefore, like to advise you to watch for the lettering "Tubeless" or "Schlauchlos" to prevent mix-ups.

## Tire Pressure

Tubeless tires keep the pressure much longer than tires with inner tubes and customers as well as workshops are beginning to see the advantage. Here and there, the opinion seems to prevail that the tire pressure no longer requires the same degree of observation and attention as was essential previously. This opinion is mistaken and quite dangerous.

The tubeless tire reacts to insufficient pressure just as unfavorably as a tire with inner tube. It will become excessively hot, diminishing road holding qualities and even causing the car to skid.

In the case of tires with inner tubes, a certain loss in pressure had come to be taken for granted and the pressure was checked and corrected regularly. With tubeless tires, a noticeable loss in tire pressure, is, however, an indication that something is wrong with either the wheel, the tire, or the valve. If, after a loss in tire pressure has been noticed repeatedly, no leaks can be detected in the outer cover (including the bead), the following causes may come into consideration:

- a - leaky rim (replace rim).
- b - leaky valve (replace valve or valve core).
- c - foreign matter or unevenness between the tire and its seat in the rim (clean or straighten the tire bead and the tire seat in the rim).
- d - inadequate tire seat in the rim in the case of exceptional border-line tolerances (replace disc wheel and outer tire).

In the last-mentioned instance (d), disc wheel and tire should not be used again until we have had an opportunity to examine them with a view to determining the cause of the pressure loss. However, this applies only to the domestic market. On principle, it may be said that to merely adjust the pressure and to then let the customer continue to operate the vehicle as it is, would not be an acceptable practice.



## 1 - VW Special Service Tools

—

## 2 - VW Workshop Equipment for Local Manufacture

VW 636     Hub Cap Removal Tool

## 3 - Normal Hand Tools

Screwdriver, 6 mm  
Combination pliers  
Pipe wrench  
Cold chisel  
Pin punch, 4 mm  
Mechanic's hammer, 300 grams  
Flat file, 180 mm in length  
Half-round file, 180 mm in length  
Flat scraper  
Socket wrench, 17 mm  
Socket wrench, 19 mm  
Open-end wrench, 7 mm  
Open-end wrench, 10 mm  
Box wrench, 17 mm  
Box wrench, 19 mm  
Wire brush  
Tire tool  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl  
Tire gauge, 0—6 kg/cm<sup>2</sup> (85 lbs./sq. in.)  
Caliper square, 300 mm in length, measuring 1/50 mm  
Tap M 10  
Tap M 10 x 1.0  
Tap M 12 x 1.5  
Die stock, size 2  
Die M 10  
Die M 10 x 1.0  
Die M 12 x 1.5  
Tap wrench, size 1, adjustable  
Tap wrench, size 2, adjustable  
Torque wrench, 0—12 mkg  
Drill, 8.5 mm  
Drill, 10.0 mm  
Drill, 10.5 mm  
Drill, 12.0 mm  
Inspection lamp with cable and plug  
Electric drill

## 4 - Supplementary Workshop Equipment

Brake cable conduit tube grease injector  
Hub cap retaining spring rivet tools  
Wheel balancer  
Fill-bleeder tank

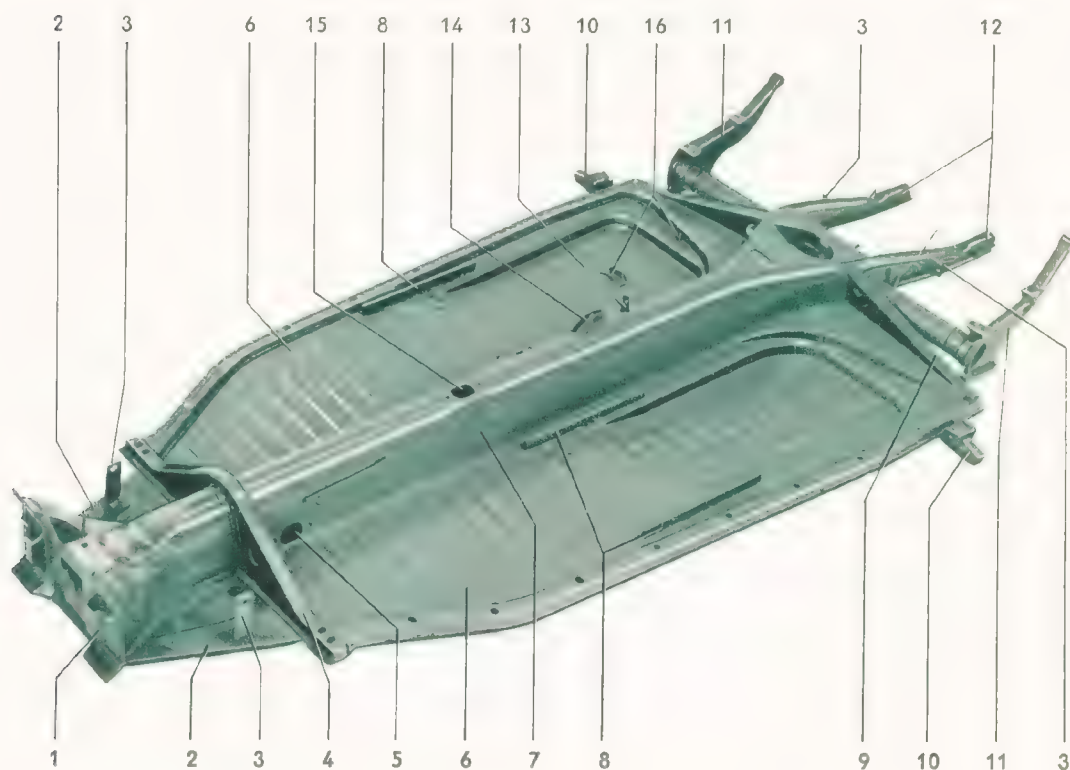


## Contents:

- 1 - Description of Frame**
- 2 - Frame Removal and Installation**
- 3 - Pedal Cluster**
- 4 - Frame Repair**
- 5 - Special Hints**
- 6 - Tools and Appliances**

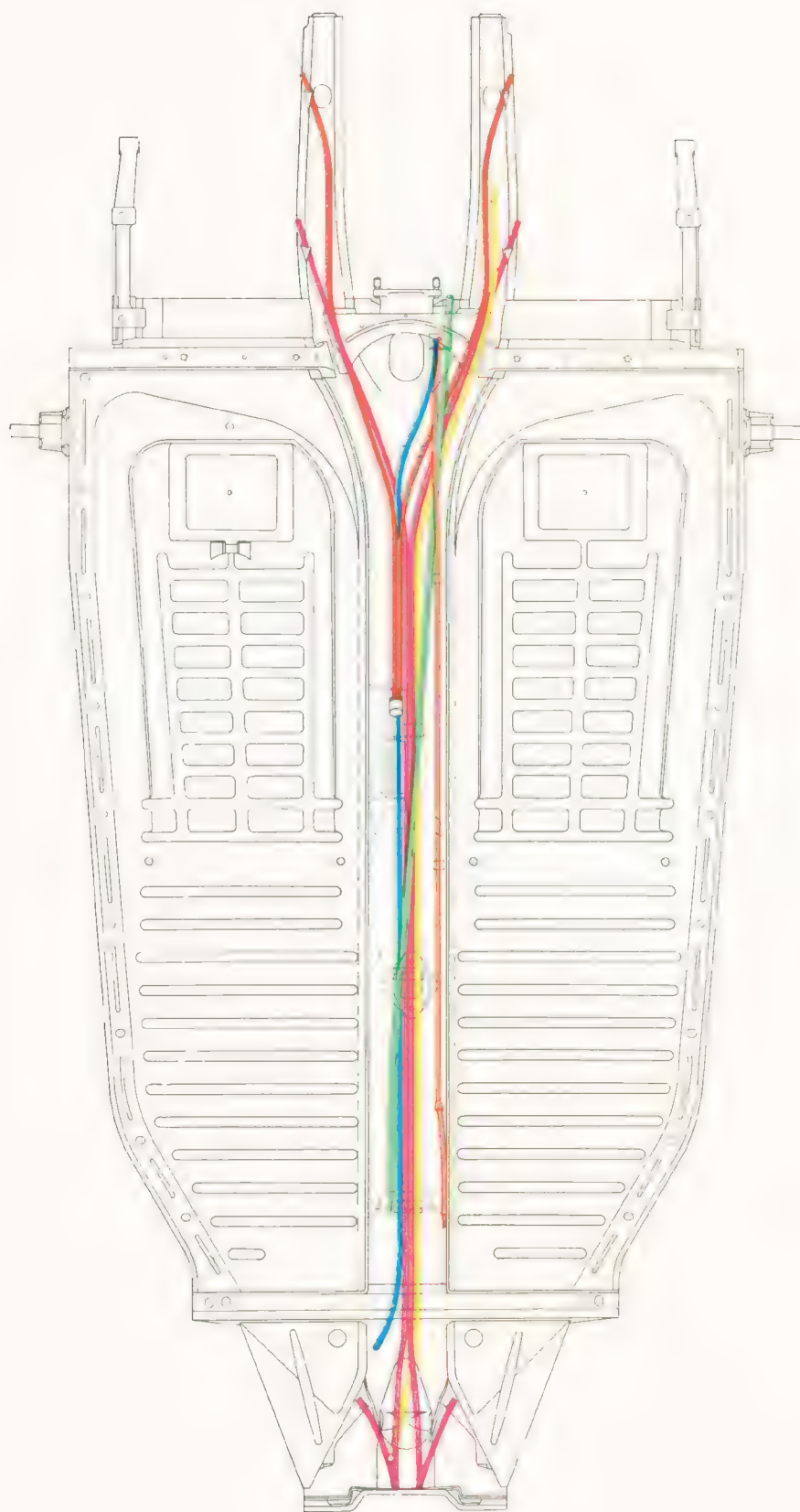


The platform-type frame of the Volkswagen is built around a tubular spinal member (tunnel), the forked rear end of which serves to support the transmission and engine assembly. The front end of the tunnel forms a wide head to provide support for the front axle. At the fork, a cross tube for the two rear torsion bars is welded into position. The ends of the cross tube carry the spring plate supports. A metal plate is welded to the underside of the frame. The frame head, consisting of pressed sheet metal, is welded to the tunnel. The platform consists of two pieces of ribbed sheet steel welded into position between the front cross member and the frame end plate. A square socket for the car jack is provided on either side underneath the platform. The frame is to a large extent distortion-free. The flat underside of the frame lessens the air resistance, facilitates a car wash and allows the car to be driven over extremely bad roads and cross-country without difficulty.



- |                            |                           |  |
|----------------------------|---------------------------|--|
| 1 - Frame head             | 7 - Frame tunnel          | 13 - Heating control knob mounting     |
| 2 - Reinforcement plate    | 8 - Seat runners          | 14 - Hand brake lever mounting bracket |
| 3 - Brake hose retainer    | 9 - Frame end plate       | 15 - Aperture for gearshift lever      |
| 4 - Front cross member     | 10 - Jack socket          | 16 - Battery mounting                  |
| 5 - Hole for pedal cluster | 11 - Spring plate support |  |
| 6 - Floor plate            | 12 - Frame fork           |  |

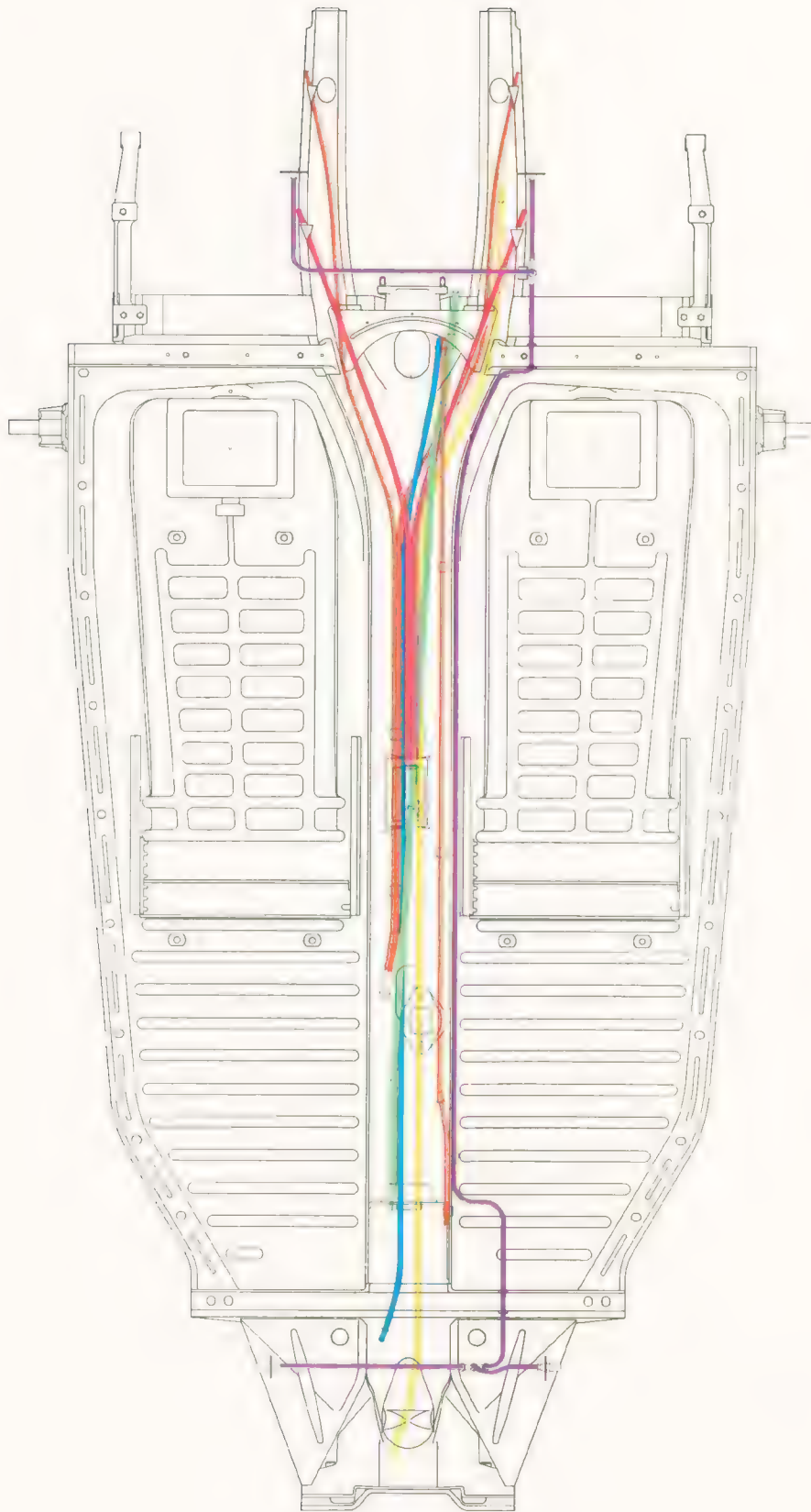
Fuel line and conduit tubes for brake, clutch, throttle, choke, and heating control cables run through the frame tunnel where they are protected from the elements. The frame tunnel also carries the gearshift rod and the brake push rods (Standard Model). On the frame tunnel, provision is made for connecting pedal cluster, hand brake lever, gearshift lever, and heating knob. The battery mounting parts are welded to the right-hand floor plate. Both floor plates are provided with front seat runners (De Luxe) or studs (Standard Model).



**Frame with conduit tubes and fuel line**

(Standard Model)

- |                             |                               |
|-----------------------------|-------------------------------|
| — Fuel line                 | — Throttle cable conduit tube |
| — Clutch cable conduit tube | — Brake cable conduit tube    |
| — Choke cable conduit tube  | — Heating cable conduit tube  |



**Frame with conduit tubes, brake lines, and fuel line**  
(Deluxe model — from Chassis No. 1—0929746)

- |                             |                               |
|-----------------------------|-------------------------------|
| — Fuel line                 | — Throttle cable conduit tube |
| — Brake line                | — Hand brake conduit tube     |
| — Choke cable conduit tube  | — Heating cable conduit tube  |
| — Clutch cable conduit tube |                               |





# Frame Removal and Installation

# R

It is recommended to adopt the following procedure for removing and installing the frame:

## Removal

- 1 - Place car on trestles.
- 2 - Remove seats and floor mats.
- 3 - Remove wheels.
- 4 - Remove gearshift lever, spring, and stop plate.
- 5 - Remove battery.
- 6 - Remove body.
- 7 - Remove engine.
- 8 - Remove rear axle complete with brake cables.
- 9 - Remove front axle (on Standard Model complete with brake cables).
- 10 - Remove rear suspension (spring plates and torsion bars).
- 11 - Hydraulic Brake:  
Remove brake master cylinder and fluid reservoir.  
Remove hand brake push bar.  
Detach the three-way connecting piece and remove brake lines.  
  
Mechanical Brake:  
Remove stop light switch.  
Remove the two brake push bars.
- 12 - Remove hand brake lever and ratchet assembly.
- 13 - Remove pedal cluster.
- 14 - Remove clutch cable and accelerator cable.
- 15 - Withdraw rubber grommets from the heating cable conduit tubes and remove heating cable.
- 16 - Remove rubber boot at the rear end of the conduit tubes for clutch cable, accelerator cable, and choke cable.
- 17 - Remove gearshift rod.
- 18 - Remove body sealing strip and rubber packings at body rear mounting points.

## Installation

Reverse the preceding operations and observe the following points:

- 1 - Check frame for distortion and damage. Whenever the fork, the rear cross tube or the backbone are found to be distorted or damaged, the frame should be replaced.

### Note:

The frame 11700021 a is no longer available and is replaced by 11700021. The front seat runners should be installed subsequently. The frames 15700021 and 15700021 a have also been discontinued. Should the necessity arise, use the corresponding frames of the sedan in place. The only modification involved is to cut off the sockets for the jack.

From Chassis No. 1600440 the anchor of malleable iron casting in the rear transverse member for supporting the torsion bars and the transmission has been replaced by a welded construction of steel pipe and pressed steel sheets.

Torsion bars of new design (part No. 111511111A) can also be installed singly in frames of older design. Once stocks are used up only torsion bars of new design will be available as spares.

### VW De Luxe Model

In connection with the new pedal cluster from Chassis No. 1600440 the frame has also been altered.

The frame tunnel near the accelerator pedal is slightly recessed and accommodates the conduit tube for the accelerator cable.

The conduit tubes for the hand brake cables in both arms of the frame fork have been positioned 50 mm (1.97") further towards the front.

Replacement of a frame of previous design with one of new design (part No. 113700021D, 114700021C, 141700021A) is only possible if the new pedal cluster, the new hand brake cables (part No. 113609721D) and the new brake line (part No. 113611781A, left 113611782A, right) are installed. The two brake back plates must then be turned by 180°, they must not be interchanged. Torsion bars of previous design may be used.

Frame and pedal cluster of previous design will still be available as spare parts.

### VW Standard Model

Frames of previous design (Part No. 111700021C to Chassis 1600440) are no longer available and are replaced by frames, Part No. 111700021E the frame tunnel of which are recessed near the accelerator lever.

If a new frame is installed with an old pedal cluster the protruding front end of the conduit tube for the accelerator cable must be adapted and the bearing hinge for the accelerator lever is to be removed.

2 - Clean and check conduit tubes for bends.

3 - Adjust rear suspension as specified.

4 - Use new lock plates (tab washers) for front axle mounting and clamping screw at the steering column coupling.

5 - Use new sealing strip between body and frame.

**6 - Hydraulic Brake:**

Make sure the brake hoses are installed as detailed in the section "Brakes and Wheels".

Bleed and adjust brake system.

**Mechanical Brake:**

Adjust brake.

7 - Check toe-in, camber, and castor.

8 - Check electrical system.

9 - Road-test the car.

Reference should be made to the corresponding sections containing detailed information and special hints as to the correct removal and installation of the individual parts.

## Pedal Cluster Removal and Installation

### Removal

- 1 - Place car on trestles.
- 2 - Remove driver's seat.
- 3 - Detach clutch cable from clutch operating lever on transmission case.
- 4 - Mechanical Brake:
  - a - Remove frame head cover.
  - b - Detach cable from stop light switch and remove stop light switch.
  - c - Remove cotter pin, plate, and cover from brake cable junction head.
  - d - Unhook brake cables.
  - e - Unhook the return spring of the brake push bar by means of a piece of wire and attach the wire to the lock nut of the torsion bar anchor.
  - f - Withdraw the brake push bar 5—10 cm (2"—4") towards the front.

clutch pedal in a vertical position to prevent the cable becoming disconnect from the pedal shaft hook.



- 7 - After having removed the pedal cluster mounting screws, withdraw pedal cluster and unhook clutch cable.

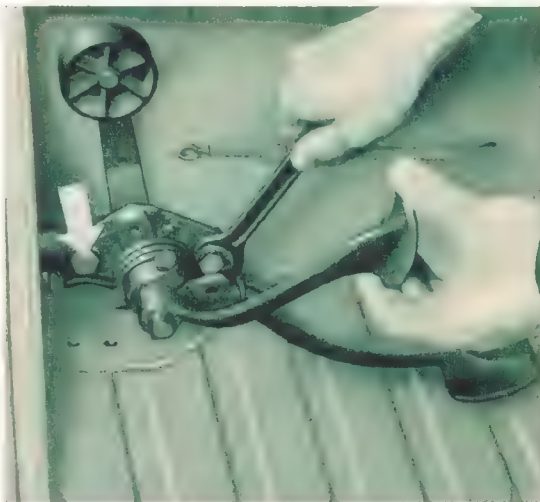
### Important!

Prior to removing the pedal cluster it is absolutely necessary to withdraw the brake push bar towards the front. The push bar is otherwise liable to suffer damage.

### Hydraulic Brake:

Detach master cylinder piston push rod from brake pedal.

- 5 - Disconnect accelerator cable from pedal.
- 6 - Remove clutch pedal shaft bracket and brake pedal stop plate. When doing this, hold the





## Installation

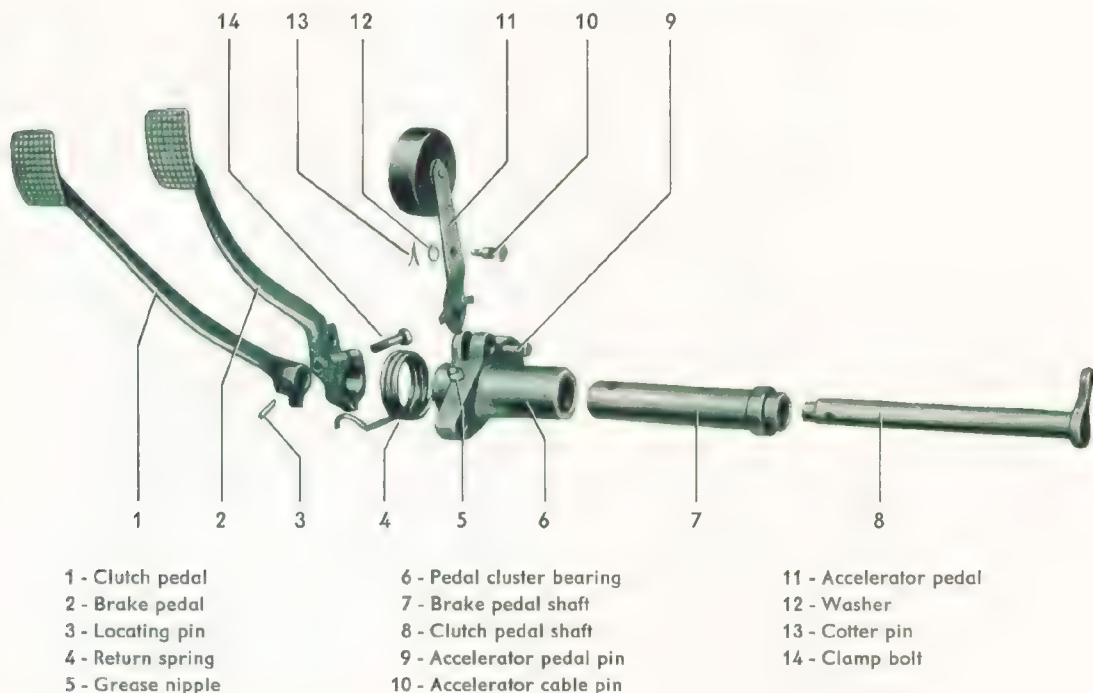
Installing the pedal cluster is a reversal of the removal procedure, but the following points should be heeded:

- 1 - Clean pedal cluster and check for damage and undue wear.
- 2 - Smear all moving parts with Universal Grease VW—A 052 and check for free movement.
- 3 - With the cable eye attached to the clutch pedal shaft hook, the pedal must be held in a vertical position to prevent the cable from becoming disconnected. It is recommended in this connection that an assistant pulls a tension at the other end of the cable.
- 4 - Adjust brake pedal stop plate so that —  
 Hydraulic Brake — the piston push rod has a clearance of 1 mm (0.04") in the master cylinder piston;  
 Mechanical Brake — no play can be felt at the brake pedal.
- 5 - Hook the return spring to the brake pedal. The slightly bent end of the spring must bear on the front mounting screw (see illustr. on the right).



- 6 - Adjust clutch pedal free play as prescribed.
- 7 - Mechanical Brake:  
Check prescribed play between foot brake push bar and hand brake push bar, adjust if necessary.
- 8 - Road-test the car.

## Disassembly and Assembly of Pedal Cluster



### Disassembly

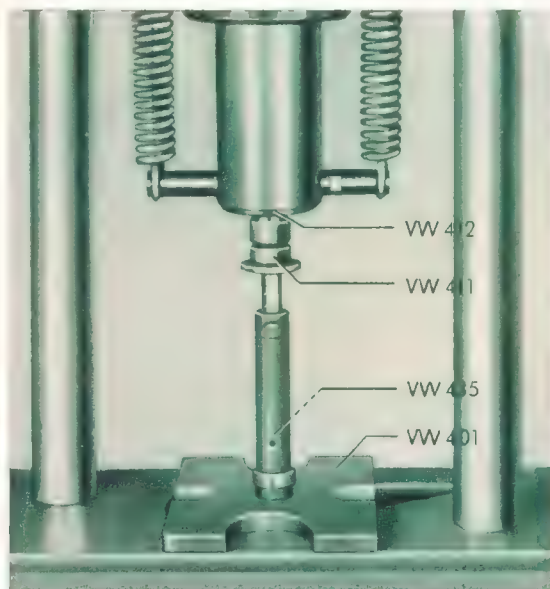
- 1 - Drive out accelerator pedal pin and remove accelerator pedal.
- 2 - Drive out the locating pin and withdraw clutch pedal and clutch pedal shaft.



- 3 - Release brake pedal clamp screw and take off brake pedal and shaft. With the mechanical brake, the Woodruff key should be taken off prior to removing the shaft.



- 4 - Remove brake pedal return spring.
- 5 - Extract brake pedal shaft bushes if excessively worn.
- 6 - Drive out clutch pedal shaft bush, if excessively worn, on VW Repair Press in conjunction with VW 412, VW 411, VW 435 and VW 401.

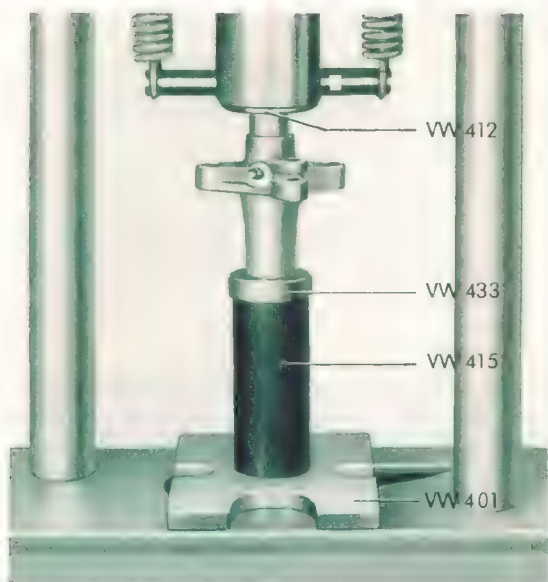


- 7 - Remove grease nipple from pedal cluster bearing.

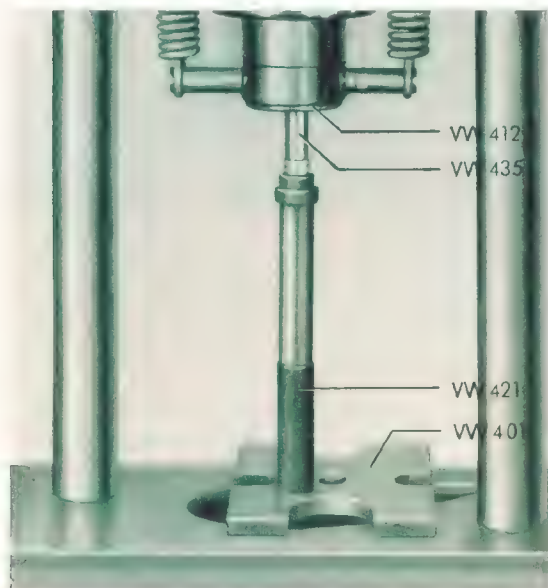
### Assembly

This is a reversal of the preceding operations, but the following points should be observed.

- 1 - Clean all parts and check them for wear and damage. Damaged or unduly worn parts should be replaced.
- 2 - Install brake pedal shaft bushes on VW Repair Press in conjunction with VW 412, VW 433, VW 415, and VW 401.



3 - Install clutch pedal shaft bush on VW Repair Press in conjunction with VW 412, VW 435, VW 421, and VW 401.



4 - Provide all moving parts of the pedal cluster with Universal Grease VW — A 052.

5 - Prior to installing the brake pedal, make sure the return spring is properly seated.

6 - Use new clutch pedal locating pin.

7 - Install grease nipple. Renew nipple if damaged.

8 - After assembly is completed, inject grease (VW — A 052) into the nipple, until the excess grease begins to emerge at the edges of the bearing points.

#### Note:

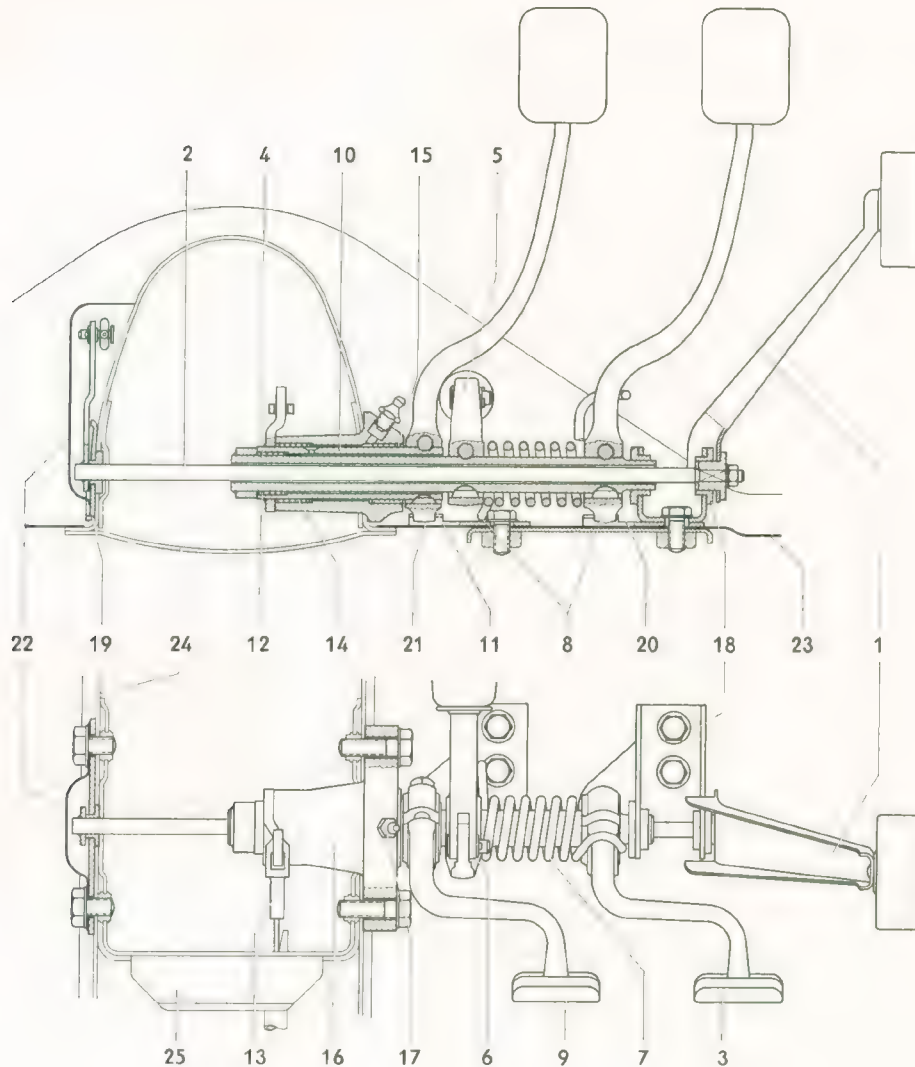
##### Standard Model

To make the accelerator lever of the VW Standard model more suitable for the various foot sizes a rubber-covered pedal has been provided in place of the previous lever with roller from Chassis No. 1600440. In this connection the shape of the brake foot lever and the mounting block has been altered.

Installation of the new accelerator lever in connection with the altered mounting block and brake lever in frames of previous design is **not** possible.



## Pedal Cluster Removal and Installation — Right-Hand Drive Cars



- 1 - Accelerator pedal
- 2 - Accelerator pedal shaft
- 3 - Brake pedal
- 4 - Brake pedal shaft
- 5 - Push rod operating link
- 6 - Push rod
- 7 - Return spring
- 8 - Keys
- 9 - Clutch pedal

- 10 - Clutch pedal shaft
- 11 - Key
- 12 - Bushing
- 13 - Clutch cable
- 14 - Bushing
- 15 - Bushing
- 16 - Mounting flange
- 17 - Lubrication fitting
- 18 - Bracket

- 19 - End flange
- 20 - Stop plate
- 21 - Stop plate
- 22 - Cover
- 23 - Floor panel
- 24 - Frame panel
- 25 - Reinforcement strut

## Removal

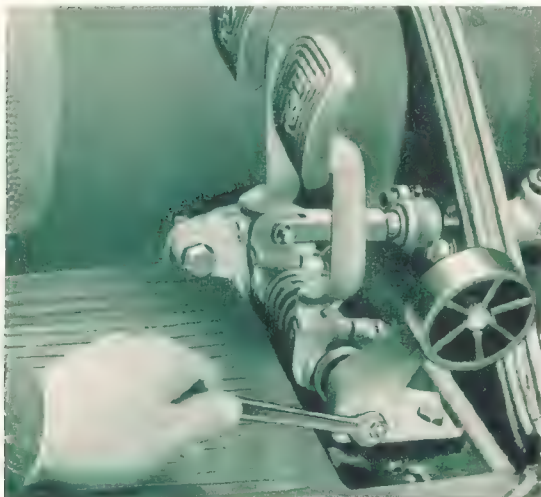
- 1 - Place car on trestles.
- 2 - Remove both front seats.
- 3 - Loosen clutch cable at clutch operating lever on transmission case.
- 4 - Mechanical Brake:
  - a - Remove frame head cover.
  - b - Detach cable from stop light switch and remove stop light switch.
  - c - Remove cotter pin plate and cover from brake cable junction head.
  - d - Unhook brake cables.
  - e - Unhook the return spring from the brake push bar.
  - f - Pull the brake push bar about 5—10 cm (2"—4") towards the front.

### Caution!

Prior to removing the pedal cluster it is absolutely necessary to pull the brake push bar towards the front. The push bar is otherwise liable to suffer damage.

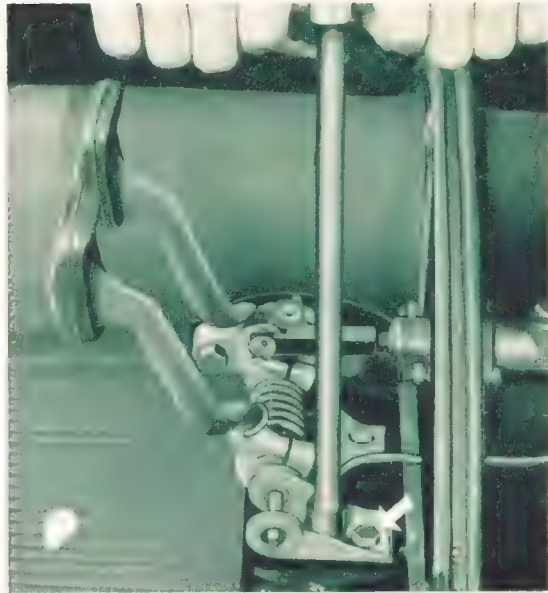
### Hydraulic Brake:

- a - Remove clevis pin from master cylinder piston push rod.
- 5 - Remove hex. nut at accelerator pedal and take off lock washer and accelerator pedal.



- 6 - Remove screws from accelerator pedal shaft bracket.

Take off lock washers, bracket, and brake pedal stop plate.

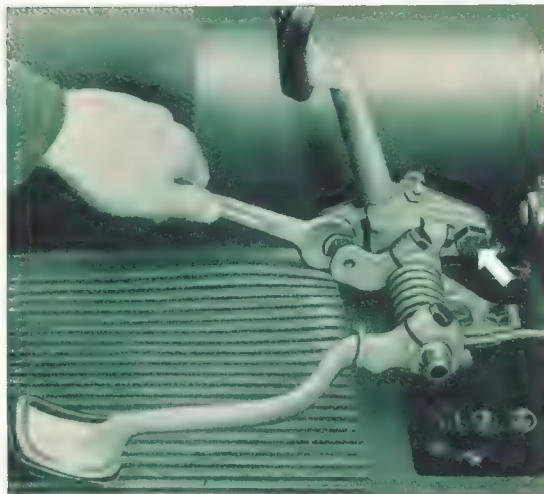


- 7 - Remove screws from cover to the left of the frame tunnel. Take off lock washers and cover.



- 8 - Detach accelerator cable from the operating lever.
- 9 - Withdraw accelerator pedal shaft and flange from pedal cluster.

- 10 - Remove screws holding the pedal cluster mounting flange and take off the lock washers.



- 5 - Adjust brake pedal stop plate so that — with the mechanical brake — no play can be felt at the pedal and — with the hydraulic brake — the piston push rod has a clearance of 1 mm (0.04'') in the master cylinder piston.

- 6 - The pads of the two pedals should be at approx. the same level. Correction should be limited to shifting the clutch pedal stop plate, as the adjustment of the brake pedal is greatly dependant on the brake system.

- 7 - Hook return spring to the brake pedal.

- 8 - Place end flange in position so that the stop (indicated by arrow) is behind and above the turning point of the accelerator pedal shaft.

- 11 - Withdraw pedal cluster and unhook clutch cable.

- 12 - If necessary, the clutch pedal stop plate may now be removed.

### Installation

Installing the pedal cluster is a reversal of the removal procedure, but the following points should be heeded:

- 1 - Clean pedal cluster and check for damage and undue wear.

- 2 - Lubricate all moving parts with Universal Grease VW — A 052 as far as accessible in assembled condition, and check for free movement.

- 3 - With the cable eye attached to the clutch pedal shaft hook, the pedal must be held in a vertical position to prevent the cable from becoming disconnected. It is recommended in this connection that an assistant pulls a tension at the other end of the cable.

- 4 - Adjust the clutch pedal stop plate so that the pedal pad is approx. vertical in the released position of the pedal.



- 9 - Adjust clutch pedal free play.

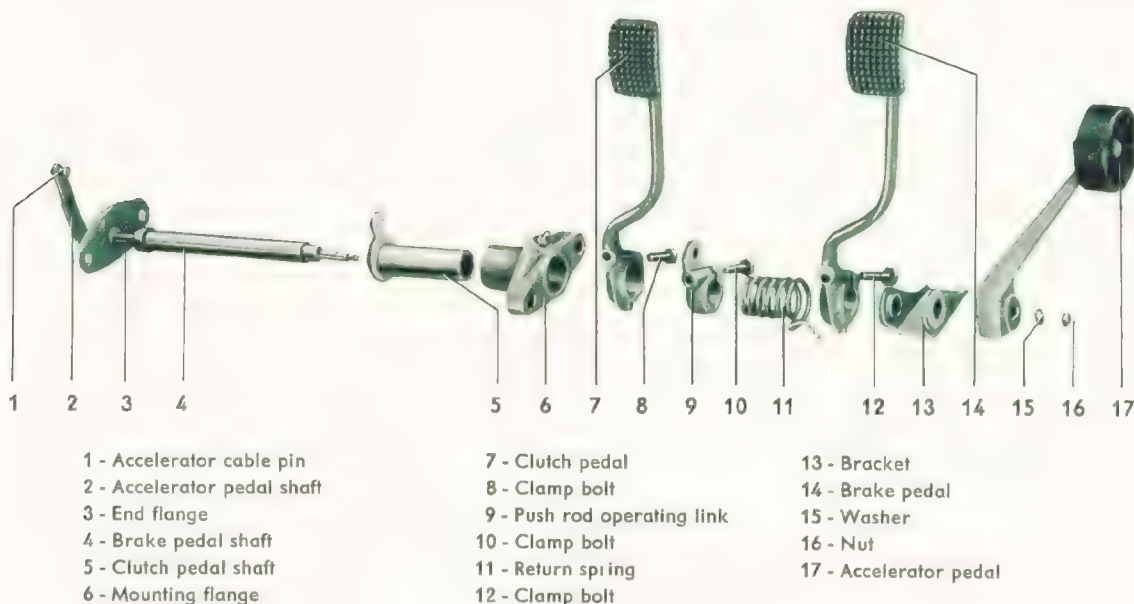
- 10 - Inject Universal Grease VW — A 052 at the lubrication fitting of the pedal cluster and check for proper functioning.

- 11 - Mechanical brake:  
Check prescribed play between foot brake push bar and hand brake push bar, adjust if necessary.

- 12 - Road-test the car.

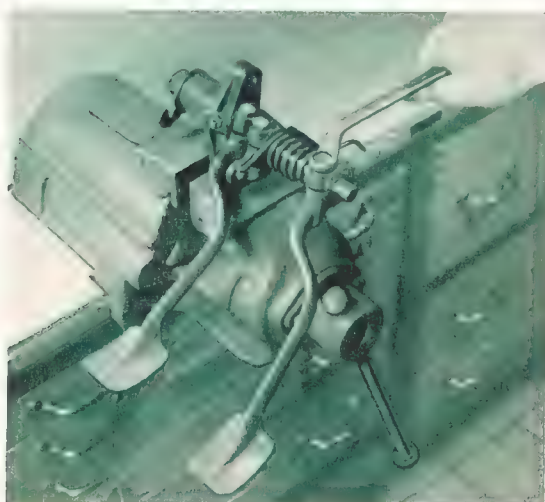


## Pedal Cluster Disassembly and Assembly — Right-Hand Drive Cars



### Disassembly

- 1 - Remove brake pedal clamp bolt and take off brake pedal.



- 2 - Remove key from brake pedal shaft and slight off brake pedal return spring.
- 3 - Remove clamp bolt from push rod operating link (hydraulic brake) or from spacer (mechanical brake) and take off operating link or spacer.

- 4 - Take off key for operating link.

#### Note:

The spacer for the mechanical brake is held in position by the clamp bolt only and is not additionally secured by a key.

- 5 - Remove clutch pedal clamp bolt and slight off clutch pedal.
- 6 - Withdraw brake pedal shaft and clutch pedal shaft from mounting flange.
- 7 - If necessary, remove clutch pedal shaft bushings from mounting flange and brake pedal shaft bushing from clutch pedal shaft.

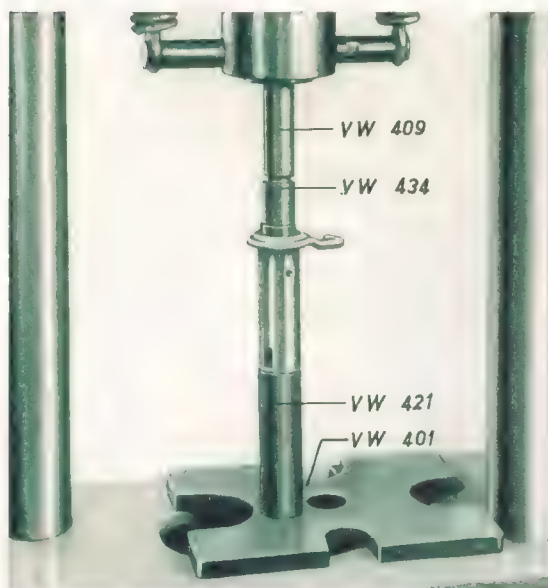
#### Note:

It is not possible to use the VW Repair Press for removing the bushings. As the bushings are slotted, therefore not being tightly seated, they can generally be removed easily with a suitable tool.

## Assembly

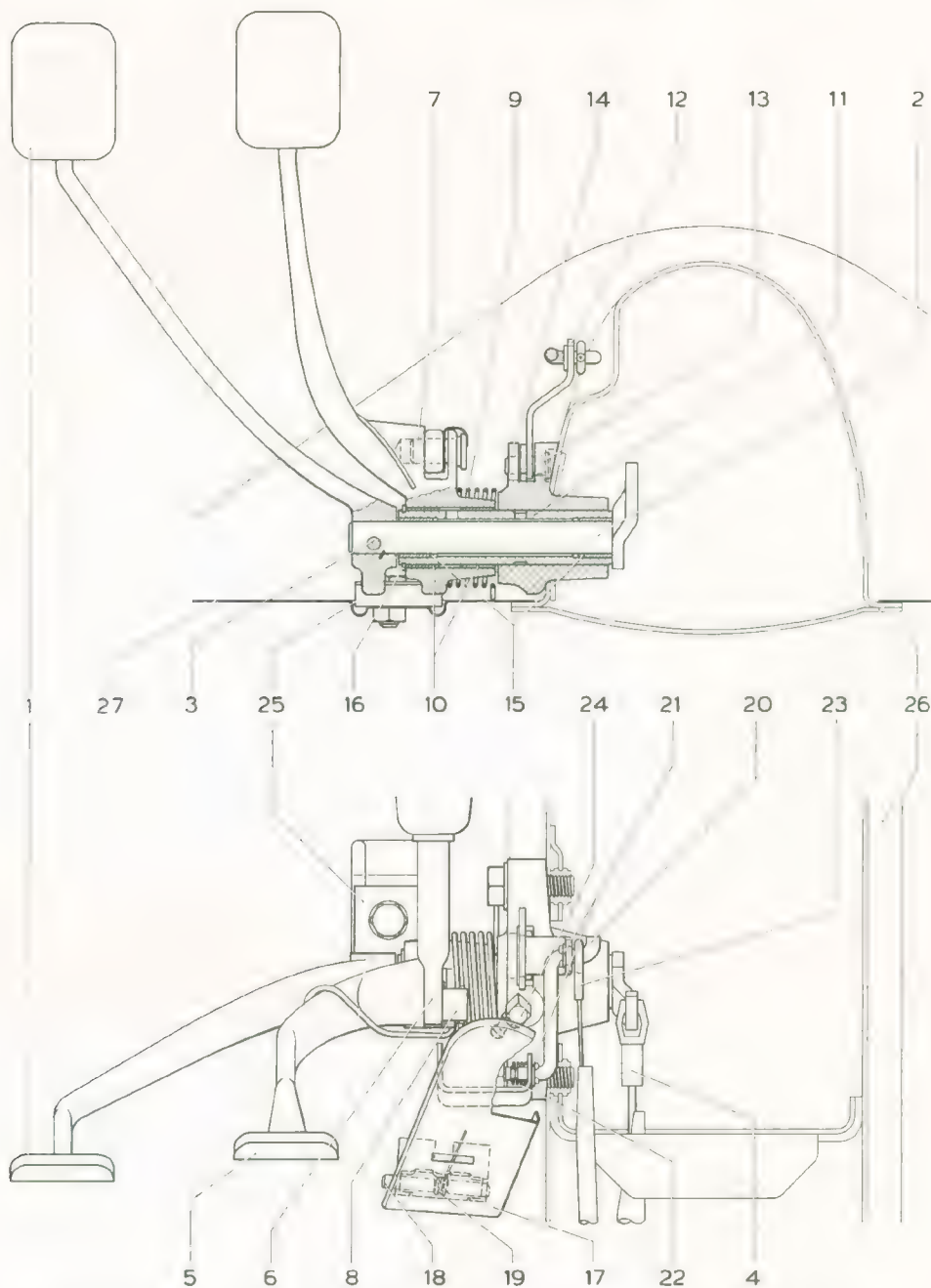
This is the reversal of the preceding operations but the following points should be observed:

- 1 - Clean all parts and check for wear and damage. Damaged or unduely worn parts should be replaced.



- 2 - If necessary, install bushing for brake pedal shaft by means of the VW Repair Press in conjunction with VW 409, VW 434, VW 421, and VW 401.
- 3 - Install bushings for clutch pedal shaft by means of the VW Repair Press in conjunction with VW 412, VW 433, VW 415, and VW 401.
- 4 - Provide all moving parts of the pedal cluster with Universal Grease VW — A 052.
- 5 - Prior to installing the brake pedal, make sure the return spring is properly seated.
- 6 - After assembly is completed, inject grease (VW — A 052) into the lubrication fitting, until the excess grease begins to emerge at the edges of the bearing points.

## Removal and Installation of Pedal Cluster



- 1 - Clutch pedal
- 2 - Clutch pedal shaft
- 3 - Locating pin
- 4 - Clutch cable
- 5 - Brake pedal
- 6 - Operating rod
- 7 - Bolt
- 8 - Securing plate
- 9 - Return spring

- 10 - Bushing
- 11 - Pedal cluster bearing tube
- 12 - Accelerator lever
- 13 - Bolt
- 14 - Mounting
- 15 - Bushing
- 16 - Securing ring
- 17 - Accelerator pedal
- 18 - Bolt

- 19 - Return spring
- 20 - Rod
- 21 - Washer
- 22 - Compression spring
- 23 - Accelerator cable
- 24 - Grease nipple
- 25 - Stop plate
- 26 - Frame tunnel
- 27 - Floor panel



## Removal

1 - Raise the car.

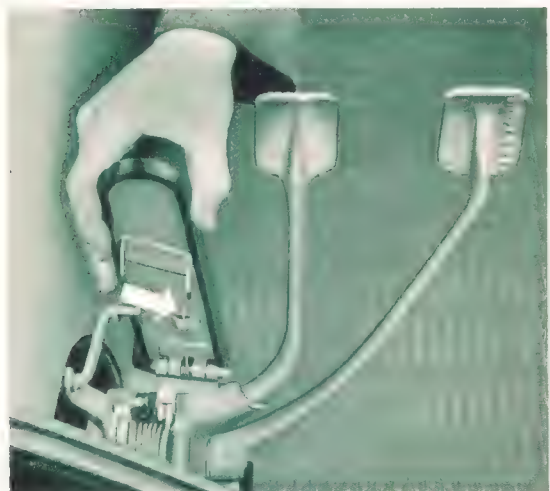
2 - Remove driver's seat.

3 - Loosen clutch cable and clutch lever. Pull off rubber seal from cable tube and push it back to the threaded piece of the clutch cable.

4 - Remove thrust spring (retaining spring) from the accelerator pedal rod and remove rod from accelerator pedal.



5 - Disengage the spring on the back of the accelerator pedal.



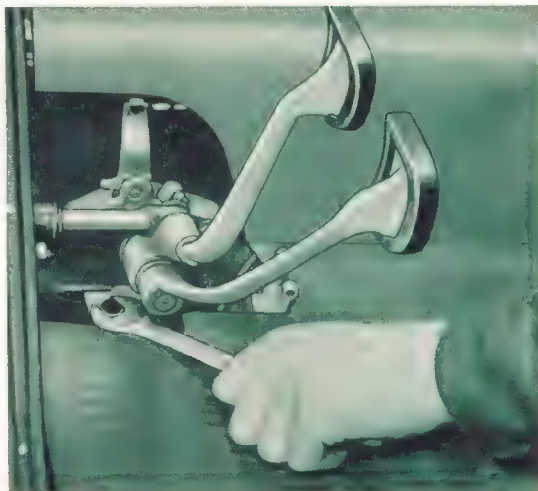
6 - Hold the spring so that the bolt for the accelerator pedal can be pulled out of the hinge. Remove accelerator pedal.

7 - Disengage the rod from the carburetor link and accelerator pedal.

8 - Bend open the securing plate and the foot brake pedal and remove the bolt for the operating rod on the brake master cylinder.

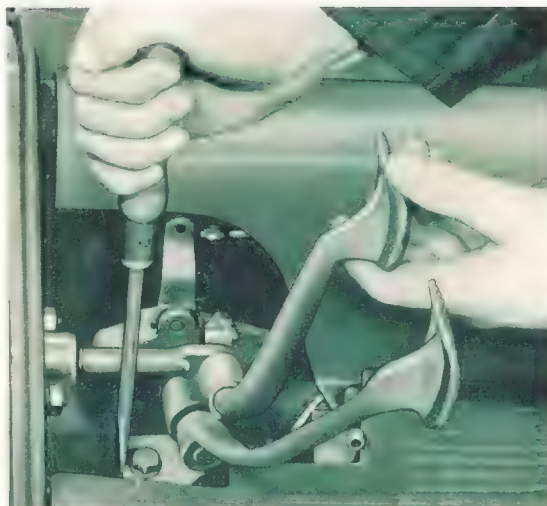


9 - Remove hex. screw and stop plate for foot brake pedal. Hold the clutch lever in the vertical position so that the clutch cable cannot disengage.



10 - Pull out the operating rod from the brake master cylinder.

11 - After removal of the two mounting screws remove pedal cluster and disengage clutch cable.



6 - Attach return spring to foot brake pedal. The other end of the spring lies on the floor plate.

7 - The short end of the return spring for the accelerator pedal must come to rest behind the hinge (in driving direction).



8 - Push the bolt of the accelerator pedal so far into the hinge that the return spring will engage in the groove in the centre of the bolt.

9 - Adjust clutch play.

10 - Lubricate pedal cluster with Universal Grease VW — A 052.

11 - Road-test the car.

## Installation

Installation is a reversal of the above. The following points should be observed:

1 - Clean pedal cluster, check for damage and excessive wear.

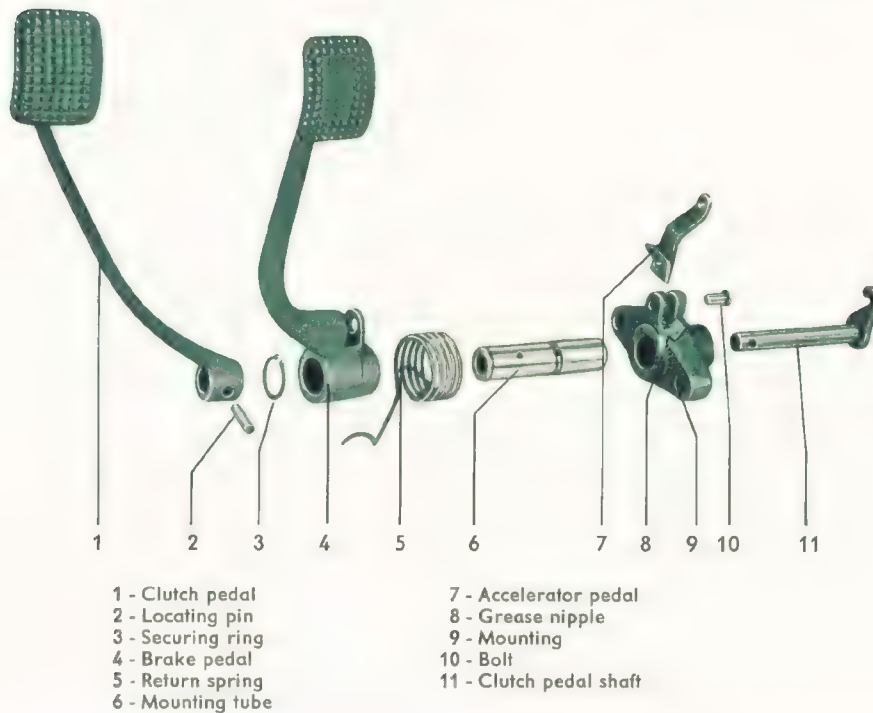
2 - Check clutch, foot brake and accelerator pedal for proper mounting.

3 - During installation of the pedal cluster check for proper position of the return spring for the foot brake pedal.

4 - Hold the clutch pedal in the vertical position so that the clutch cable cannot disengage.

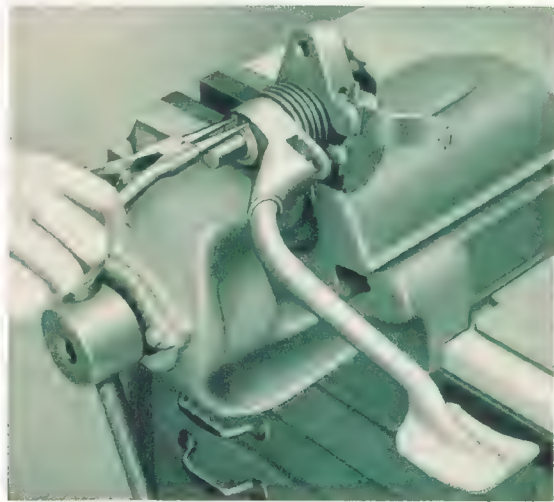
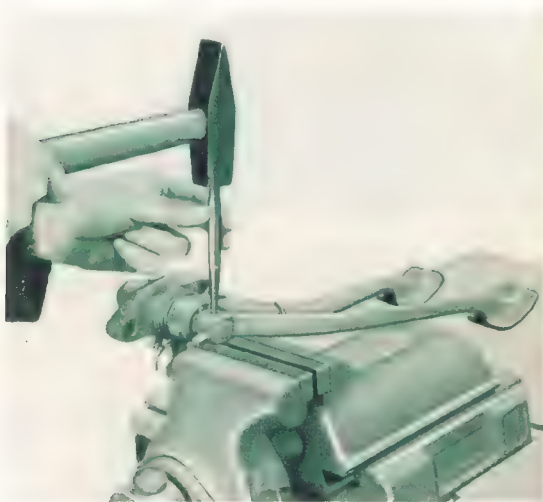
5 - Adjust stop plate for brake and clutch pedal in such way that the operating rod in the brake master cylinder has a play of approx. 1 mm (.04").

## Disassembly and Assembly of Pedal Cluster



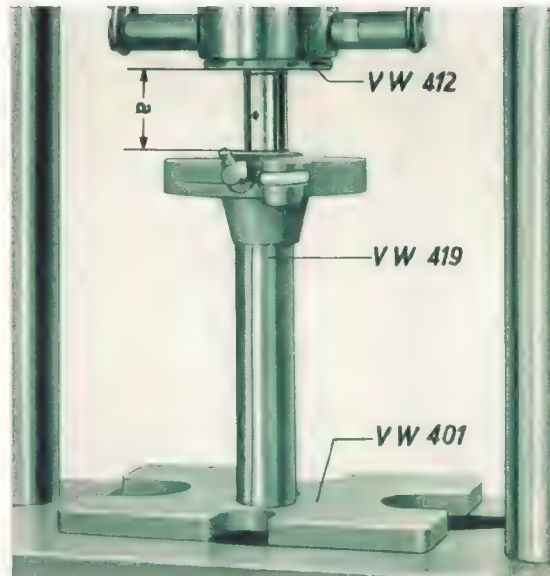
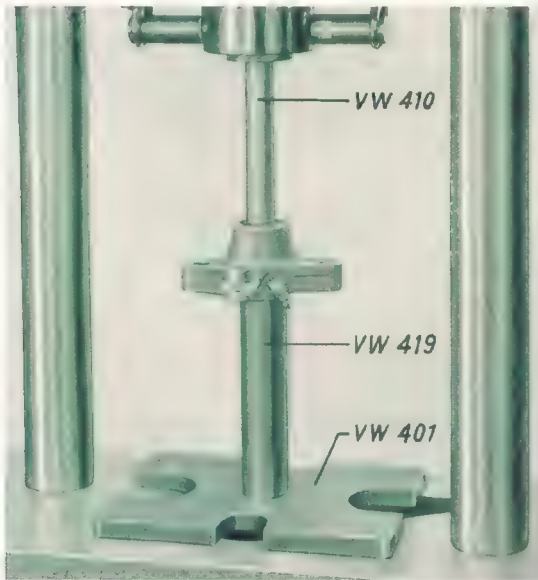
### Disassembly

- 1 - Press out bolt for the accelerator pedal from mounting and remove accelerator pedal.
- 2 - Remove clutch pedal and clutch pedal shaft after knocking out the grooved dowel pin.
- 3 - Remove securing ring from foot brake pedal tube and pull off foot brake pedal with retaining spring.





- 4 - If necessary remove foot brake pedal tube by means of VW Repair Press 400 in connection with VW 410, VW 401, and VW 419.



$$a = 43,5 - 0,5 \text{ mm}$$

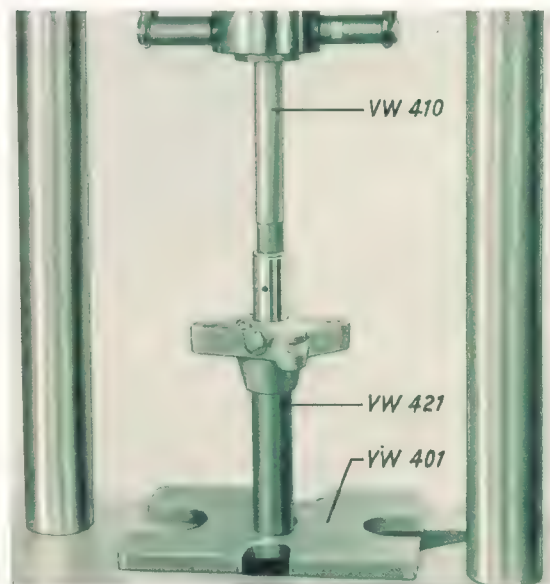
- 3 - If necessary remove the bushes for the clutch lever shaft from the mounting tube. Install new bushes by means of VW Repair Press 400 in connection with VW 410, VW 401, and VW 421.

- 5 - If necessary remove lubricating nipple from the foot brake lever mounting.

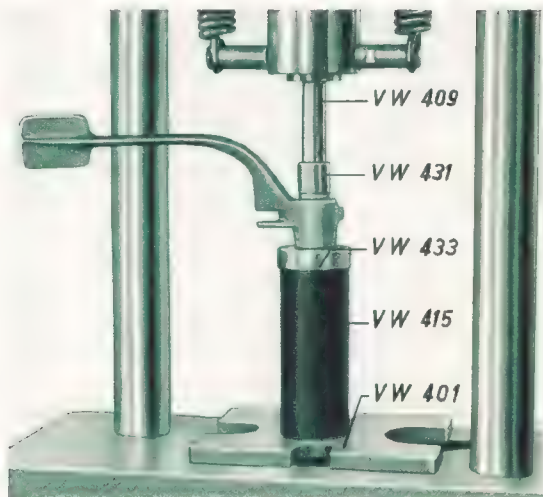
### Assembly

Assembly is a reversal of the preceding operations. The following points should be observed:

- 1 - Clean all parts and check them for wear and damage. Replace damaged or excessively worn parts.
- 2 - Install mounting tube for foot brake pedal by means of VW Repair Press 400 in connection with VW 412, VW 401, and VW 419. Dimension  $a = 43.5 - 0.5 \text{ mm}$  on the drawing should be observed. Install the mounting tube in such a way that the ring groove for the securing ring is on the left hand side of the foot brake lever mounting in driving direction.



- 4 - If necessary remove bushes for foot brake lever. New bushes should be installed by means of VW Repair Press 400 in connection with VW 409, VW 431, VW 401, VW 415, and VW 433.



5 - Before installation lubricate all mounting points with Universal Grease VW — A 052.

6 - Before mounting of the foot brake pedal make sure that the return spring is properly seating.

7 - If necessary install new locating pin for clutch pedal.

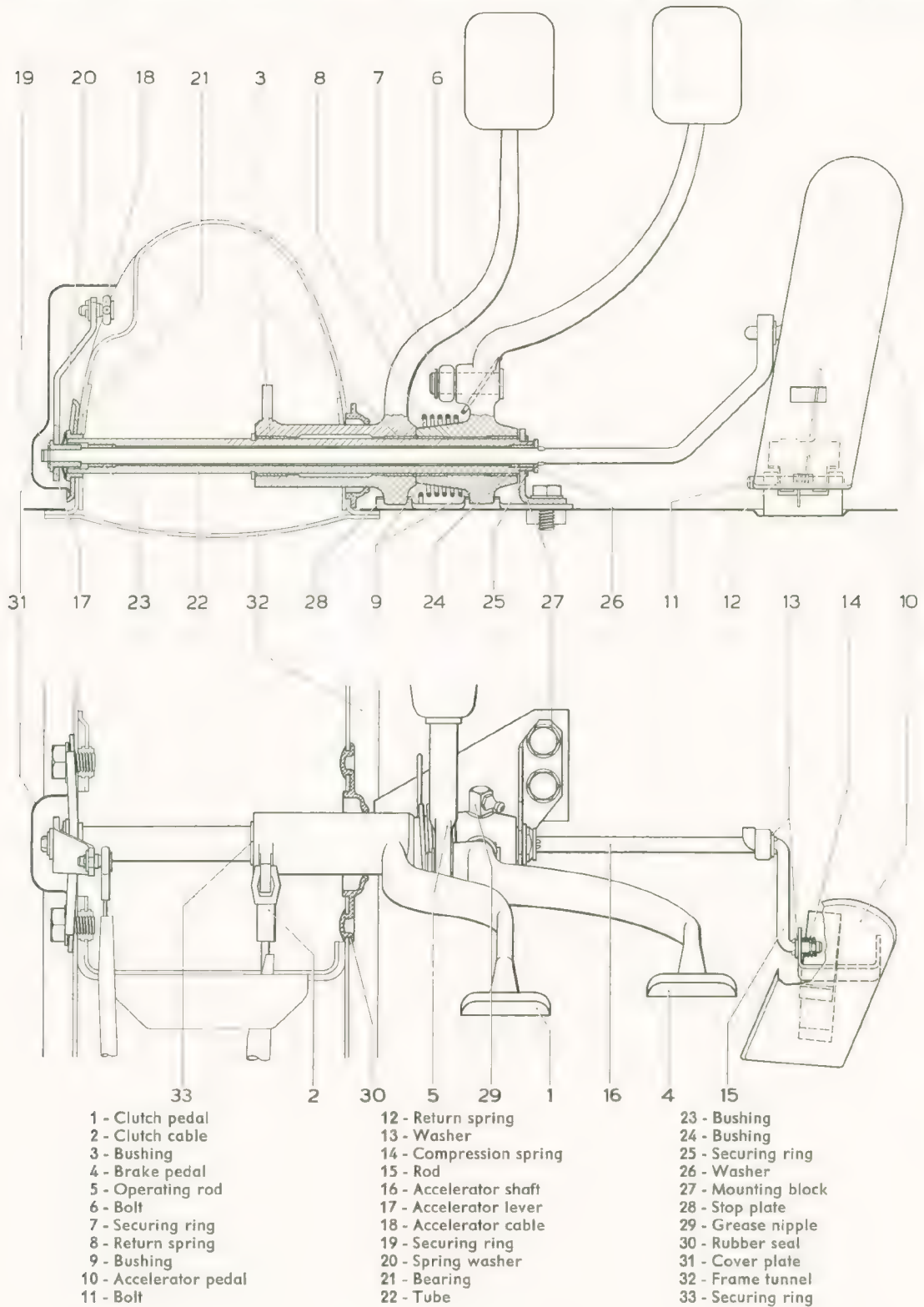
8 - When installing a new grease nipple it should be observed that the nipple head is between foot brake pedal and accelerator pedal to facilitate lubrication.

9 - After installation of the pedal cluster Universal Grease VW — A 052 should be pressed in until egress of grease is apparent at the mounting points.

**Note:**

A service installation of the new foot pedal linkage into vehicles with old type frames is not possible.

## Pedal Cluster Removal and Installation — Right-Hand Drive Cars

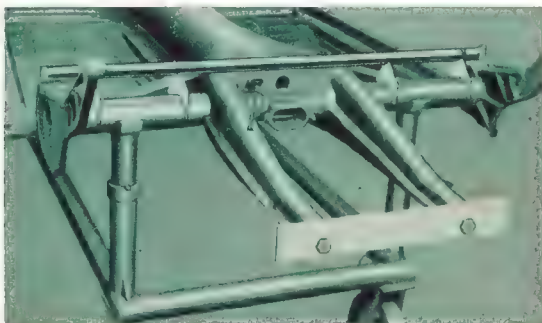




## Replacing the Frame Head

### Checking Frame Alignment

- 1 - Check alignment of the rear cross tube by using Gauge VW 375 (local manufacture). All four radius plates must make perfect contact with the cross tube.

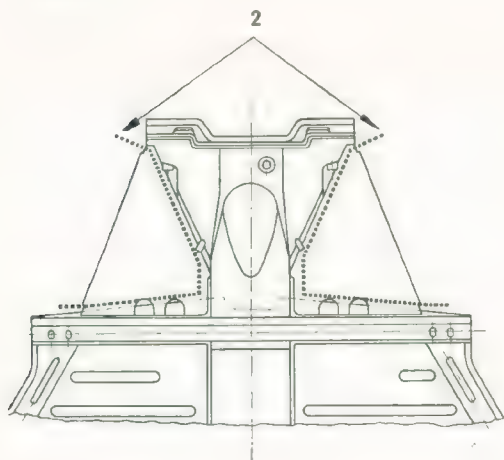


- 2 - Check fork ends of frame tunnel for twist and lateral and vertical displacement, using Template VW 376 (local manufacture).

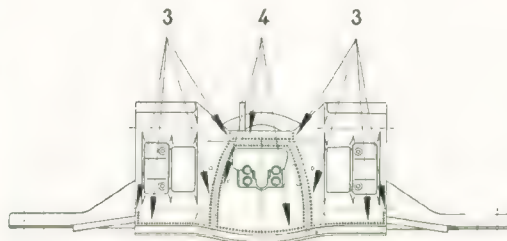
If the rear cross tube and the fork ends are found to be out of alignment, or if the frame tunnel has suffered damage, the frame is in most cases beyond economic repair.

### Removal

- 1 - Blow out frame tunnel and fuel line with compressed air to prevent an explosion of fuel or vapor later on.
- 2 - Cut out the two front reinforcement plates by means of a cutting torch (see dotted lines below).

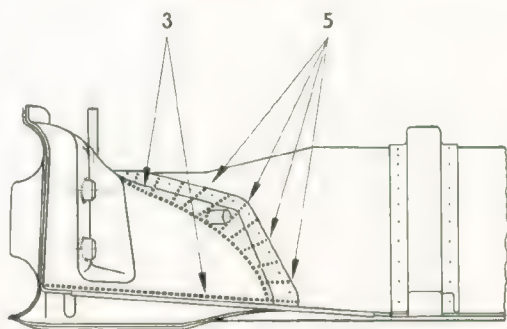


- 3 - Cut off frame head on both sides [as indicated by (3)], using a cutting torch.



- 4 - Cut off the surplus front plate from the frame tunnel by means of a cutting torch.

- 5 - Cut through the remaining pieces of the frame head, the cuts being 40 mm (1.6") apart [as indicated by arrows of (5)].



To avoid damaging the frame tunnel, the remaining pieces should be cut off with a cold chisel or torn off with heavy pliers.

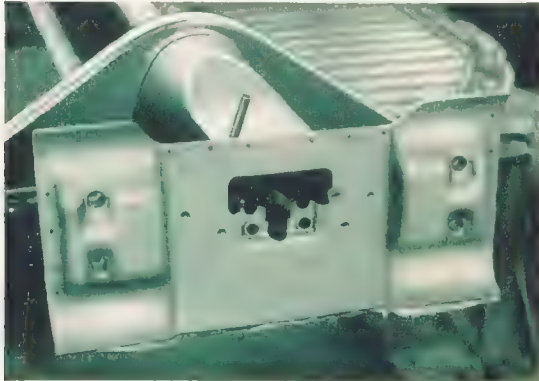
Remove upper brake cable conduit tubes of cars equipped with mechanical brakes.

- 6 - Straighten frame tunnel and base plate in cold condition and ground flush rough edges.

### Installation

- 1 - Tilt up the frame to the vertical position so that the front end is at the bottom and tap the frame tunnel to free it from foreign matter.
- 2 - Check conduit tubes for looseness.

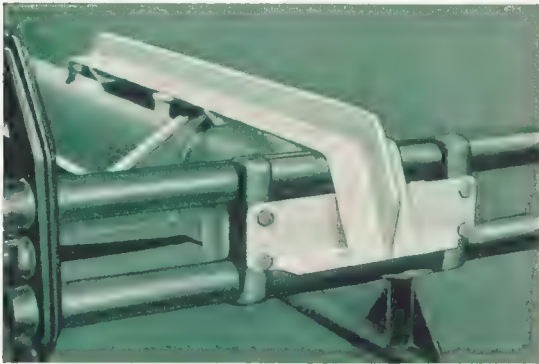
- 3 - Push front plate of the new frame head over the lower brake cable conduit tubes. Attach



This will assure the correct height of the plate.

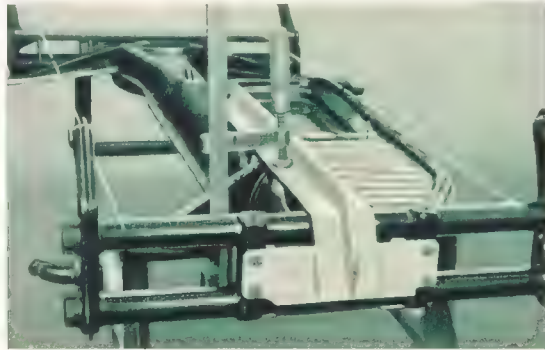


checked front axle beams and Frame Head Assembly Jig (local manufacture) to the plate, using bolts M 12 x 1.5.

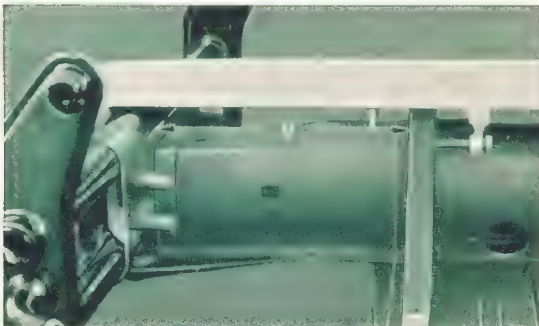


- 6 - Adjust the plate laterally by measuring the distance from the outer edges of the plate to the center line of the frame tunnel, permissible lateral displacement being 2 mm (0.08'').

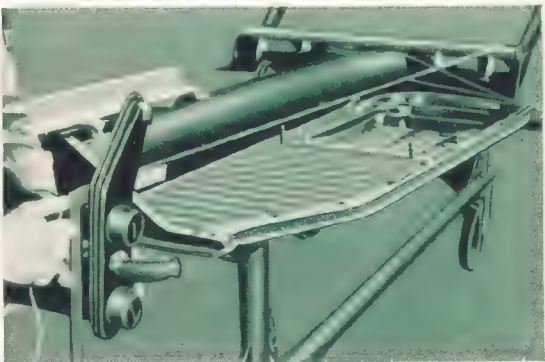
- 7 - Make sure the frame head plate and front axle beams are in line with the Gauge VW 375 on the rear cross tube (see marked lines below).



- 4 - Equally turn the two adjusting screws of the Jig VW 374 until the distance from the front plate upper edge to the frame front cross member (a) amounts to 320 mm (12.9'').



- 8 - Check parallelism between front axle beams and rear cross tube by means of Gauge VW 375, a square and a cord, on both sides of the front axle beams.

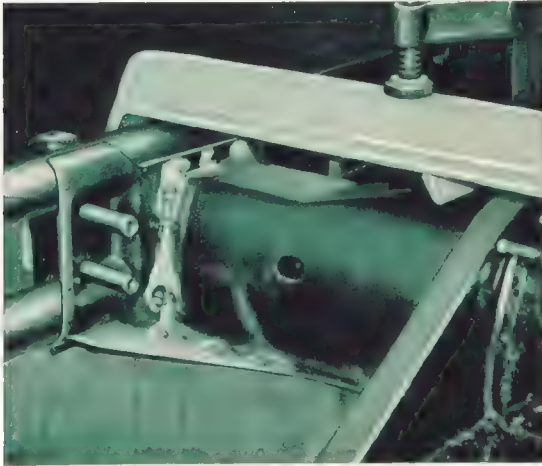


- 5 - Attach rear end of assembly jig to the front tapped hole for the gearshift lever ball housing, using the screw M 8. Tightly press the contact plates of the jig against the frame tunnel applying a clamp.



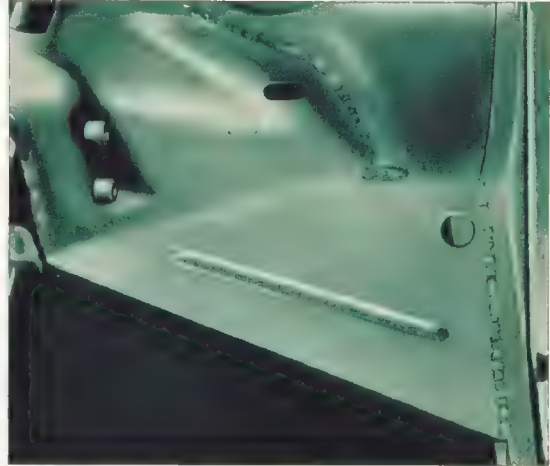
9 - Recheck alignment as outlined under the points 4—8 to avoid faults due to an accidental moving of the front plate during the checking procedure.

10 - Weld the front plate to the frame tunnel, starting at the top and working downwards on both sides. Attach the base plate to the tunnel by three welds on each side.



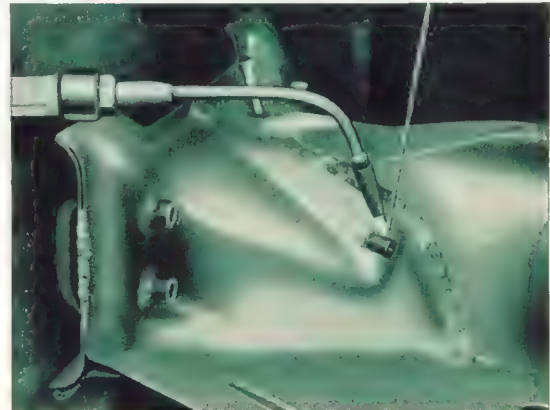
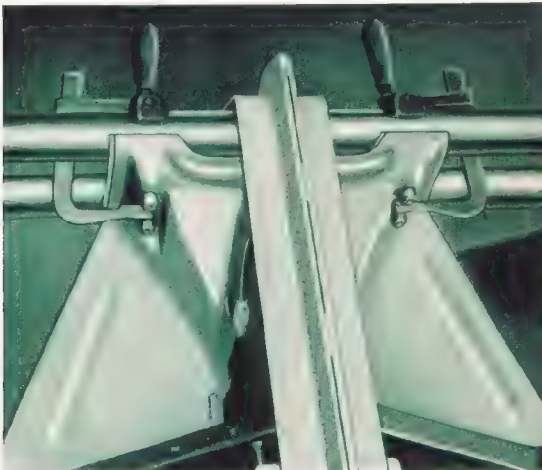
13 - Weld the reinforcement plates to the front cross member throughout their length.

14 - Remove the assembly jig and weld the frame head cover to the front plate and to the tapped bushes.



11 - Place cover and reinforcement plates in position, clamp it tightly to the front plate and weld at a few points to hold it in position.

15 - With cars equipped with mechanical brakes, weld in the cable conduit tubes. On cars having hydraulic brakes, weld the brake hose retainer in place.



12 - Continuously weld frame cover in position, starting the welding at the top and working downwards.

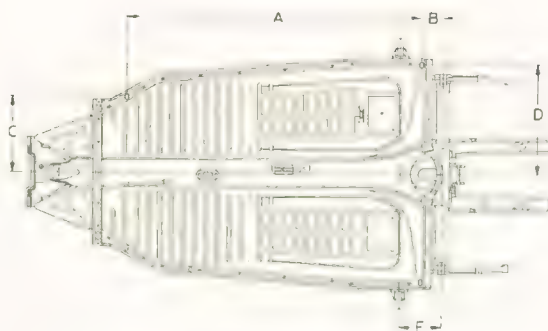
16 - Turn over the frame and complete the welding at the underside.



# Replacing Floor Plates

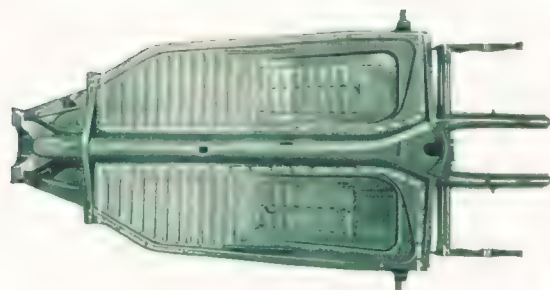
## General

Replacing the floor plates is only possible with the frame out of the vehicle. Before replacing the floor plates, remove battery, pedal cluster, and (with the De Luxe Model) the brake line on the left-hand side of the frame tunnel.



## Removal

- 1 - Cut out the floor plate by means of a cutting torch.



A = 1528.8—1529.2 mm (60.189"—60.205")  
 B = 104.5— 105.5 mm ( 4.11" — 4.15")  
 C = 402.5— 403.5 mm (15.85" —15.89")  
 D = 582 — 583 mm (22.91" —22.85")  
 E = 204 — 205 mm ( 8.03" — 8.07")

- 2 - Weld the floor plate in position by means of a spot-weld plant, the spots being 10 or 15 mm (0.4" or 0.6") apart.

- 3 - Weld the floor plate to the front cross member over the width of the reinforced edge (see arrow).

- 2 - Remove the remaining edges of the floor plate with heavy pliers or a cold chisel.

- 3 - Straighten frame edges in cold condition and ground them flush.



## Installation

- 1 - Place new floor plate in position, paying attention to the fitting dimensions.

- 4 - Paint the frame and apply VW Sealing Compound D 8 to the joints along the spot welds.

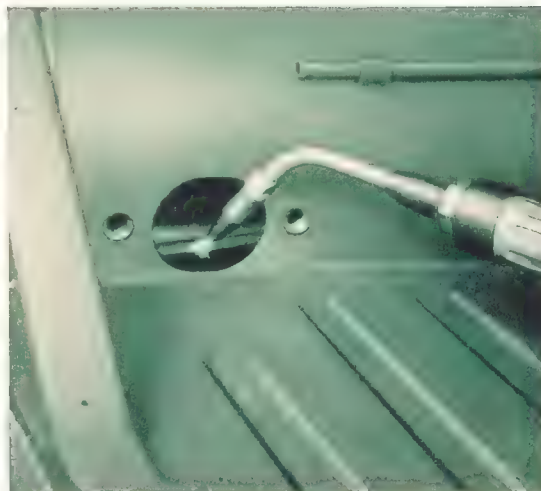
## Replacing Fuel Line

### General

Together with the conduit tubes the fuel line runs through the frame tunnel. It passes into the frame tunnel behind the frame head and comes out on the left-hand side of the fork at the rear.

Replacing the fuel line falls into two categories:

- a - The fuel line in the tunnel is replaced (with body removed) or**
- b - Another line is installed along the outside of the frame tunnel irrespective of the old line (with body in situ).**



### a - Replacing fuel line

#### Removal

- 1 - Put car on trestles.
- 2 - Remove wheels.
- 3 - Remove seats and floor mats.
- 4 - Remove battery.
- 5 - Remove gearshift lever, spring, and stop plate.
- 6 - Remove body.
- 7 - Remove the two carpets from the frame tunnel.
- 8 - Remove inspection cover at frame fork.
- 9 - Remove gearshift rod coupling.
- 10 - Pull off fuel hoses from fuel lines.
- 11 - Remove hand brake push bar (with Standard Model, also remove foot brake push bar).
- 12 - Withdraw brake cable for left-hand rear wheel from its conduit tube.
- 13 - Remove hand brake lever and ratchet.
- 14 - Pull out gearshift rod from the front end of the tunnel.
- 15 - Pull off front and rear rubber grommets from fuel line.
- 16 - Use a small torch to cut off the fuel line through the hole for the pedal cluster.

#### Attention!

Prior to using an open flame, blow out frame tunnel and fuel line with compressed air.

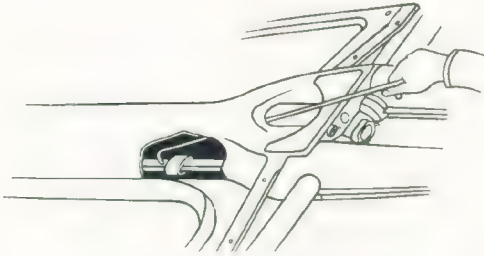
- 17 - Pull out the front end of the fuel line toward the front.

- 18 - Remove the rear end of the fuel line toward the rear. Clamp the rear end of the line in a hand vice and hammer against the vice to force the line out.



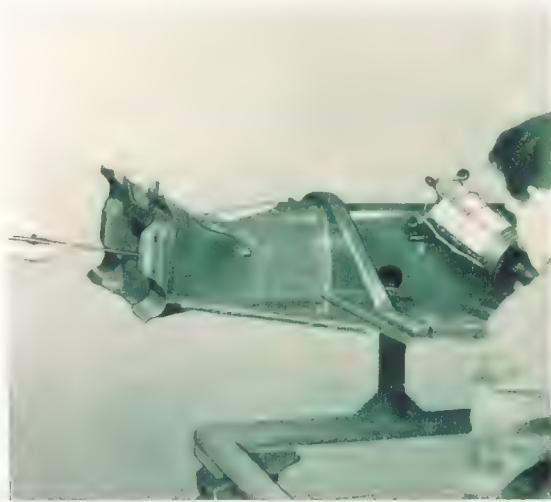
At the same time, an assistant pulls back the clip which joins fuel line and left-hand brake cable conduit tube. This is done by means of a piece of steel wire with a bent end through the inspection hole at the frame end, until the clip can be seen through the inspection hole.

It is advisable to have an assistant watching the operation with an inspection lamp. He guides the movement of the line through the holes for pedal cluster, gearshift lever, and hand brake lever. The clip removed before is omitted when installing a new line.



19 - Insert the cutting torch through the inspection hole and cut the clip. Care should be taken not to damage the conduit tube. Remove the cut clip.

20 - Completely withdraw fuel line toward the rear.

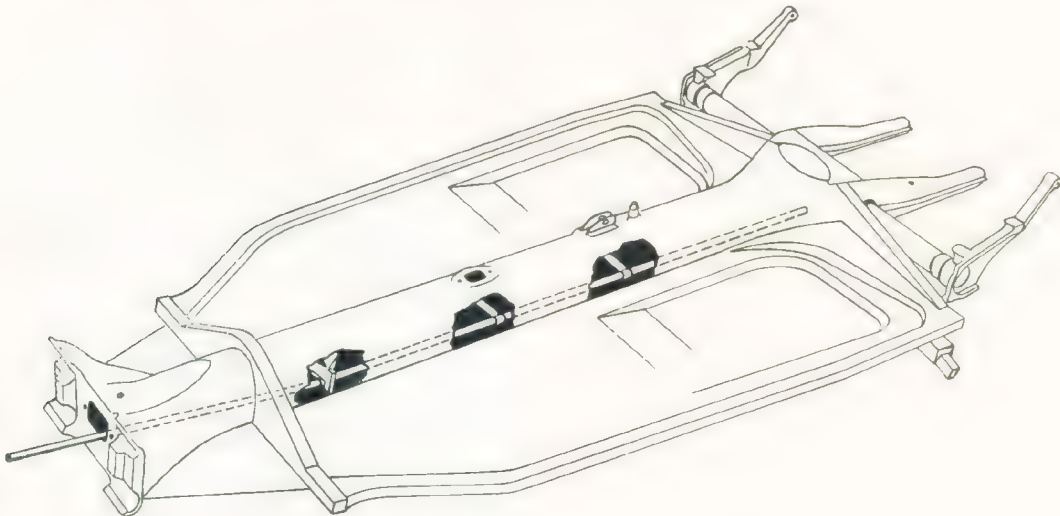


### Installation

The following points should be observed when installing the new fuel line:

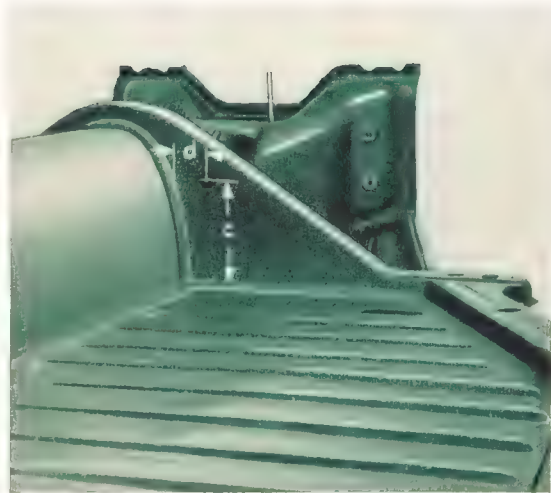
- 1 - Before inserting the fuel line, the ends should be straightened in cold condition.
- 2 - Insert the fuel line from the front through the three retainers until the inserted end can be seen through the inspection hole at the frame fork.

3 - To facilitate installing the fuel line, it is good practice to insert a piece of wire 4 mm (0.16") thick and 1.5 m (5 ft.) in length from the rear hole for the fuel line and let it enter the rear end of the line.





- 4 - Lightly tap the fuel line to force the rear end of the line through the hole in the frame fork until it is possible to insert the front end of the line in the hole provided in the frame head.
- 5 - Make sure the fuel line ends equally project from the frame to provide a good connection for the fuel hoses.
- 6 - Straighten the fuel line ends and remove any burr.
- 7 - Blow out the fuel line with compressed air and install the rubber grommets.
- 8 - After assembly is completed, adjust brakes and road-test the car.



$c = 60 \text{ mm (2.36'')}$      $d = 30 \text{ mm (1.18'')}$

#### **b - Installing new fuel line in addition**

##### **Removal**

- 1 - Place car on trestles.
- 2 - Remove wheels.
- 3 - Remove seats and floor mats.
- 4 - Remove the two carpets from the frame tunnel.

- 2 - Drill a 15 mm diam. (0.59'') hole on the left-hand side of the frame end plate.

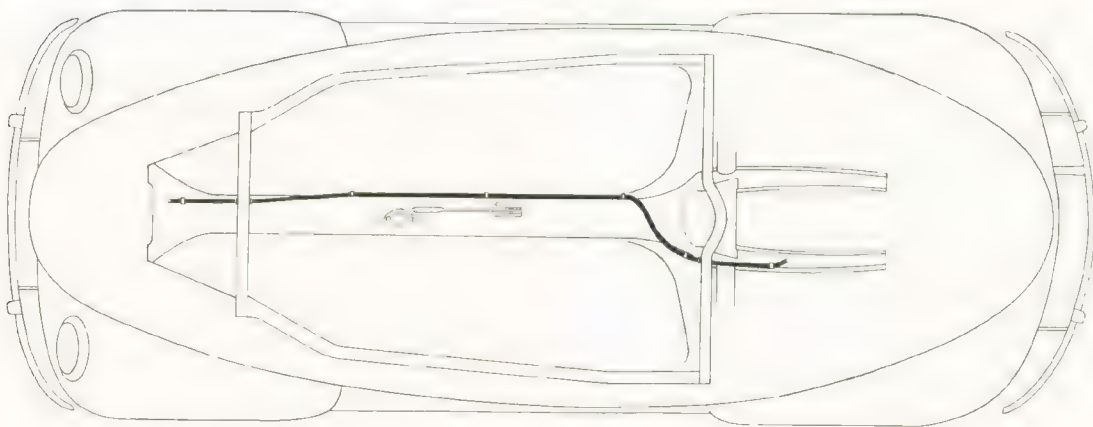


$a = 60 \text{ mm (2.36'')}$      $b = 15 \text{ mm (0.59'')}$

##### **Installation**

The following operations are necessary to install a new fuel line outside the frame tunnel:

- 1 - Drill a 15 mm diam. (0.59'') hole on the right-hand side of the front cross member.



3 - Bend fuel line (copper-plated, approx. 2600 mm /102.36") in length, according to the drawing and slide the three rubber grommets in position. The fuel line runs from below the fuel tank to the right-hand side of the frame tunnel, where it is held in position by one clip. Then the line passes through the front cross member in which it is held by two grommets. From the front cross member it runs on to the floor plate and is retained by three clips along the frame tunnel. The fuel line passes over to the other side in front of the frame fork, but care should be taken to assure that the line will not be fouled by the rear seat. On the left-hand side of the frame

tunnel, the line is held in position by a clip at the level of the hole in the frame end plate. A rubber grommet is fitted at the point where the line passes through the hole in the frame end plate. Another clip is provided on the fork. The clips can be made by metal strips 1 mm (0.04") thick and 110 mm (4.3") wide.

4 - Install fuel line and fix it in place by means of the six clips.

5 - Blow out the line with compressed air and slide on the fuel hoses.

## Replacing Shifting Rod Guide

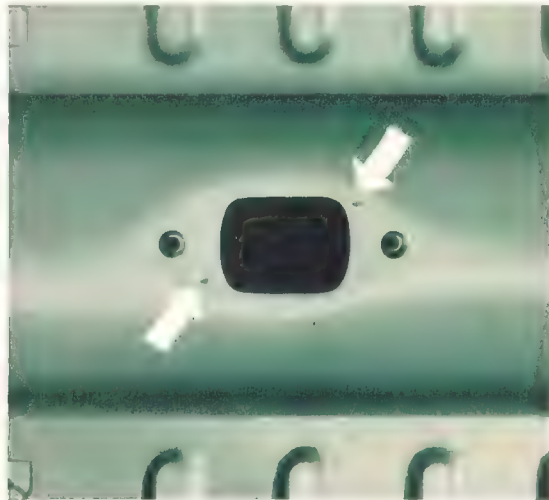
### Removal

Replacement of the shifting rod guide is only necessitated by a broken leaf spring.

- 1 - Place car on trestles.
- 2 - Remove front seats.
- 3 - Remove carpet from frame tunnel.
- 4 - Remove gearshift lever, spring, and stop plate.
- 5 - Remove hand brake push bar (with the Standard Model, also remove foot brake push bar).
- 6 - Remove gearshift rod.
- 7 - Detach gearshift rod guide from frame tunnel by means of a cold chisel.



If necessary, drill out the two spot welds (see arrows) by means of a 3 mm diam. (0.12") drill.



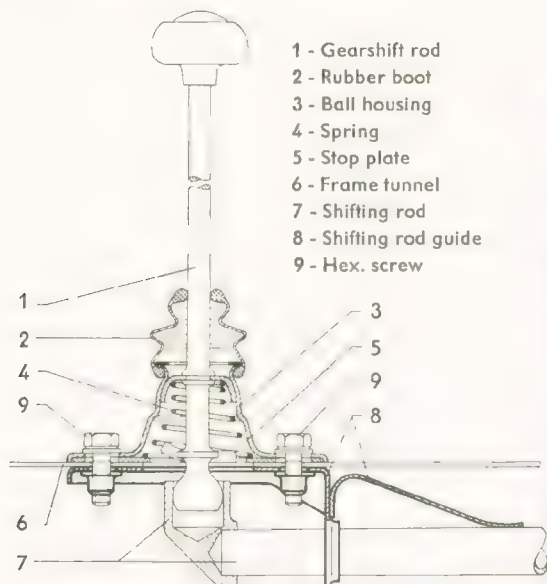
- 8 - Cut the gearshift rod guide into pieces with a cutting torch to allow the guide to be removed through the hole.

### Attention!

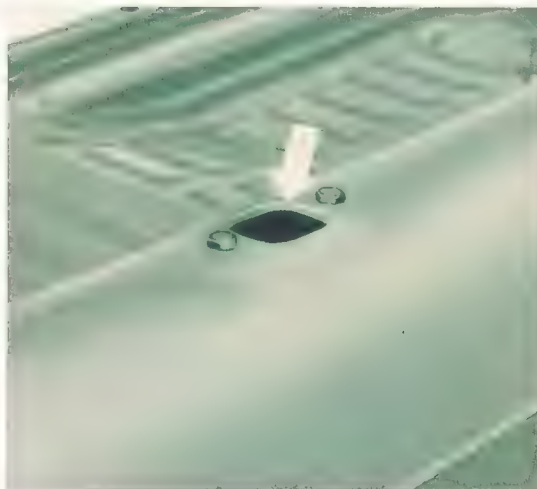
Prior to using an open flame, blow out frame tunnel and fuel line with compressed air.

## Installation

Observe the following points in installing the new guide:

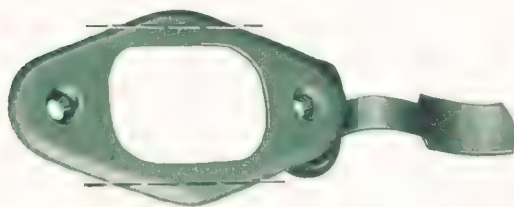


Be sure the guide makes perfect contact with the tunnel to ensure the correct distance from the tunnel upper edge to the guide longitudinal center line.

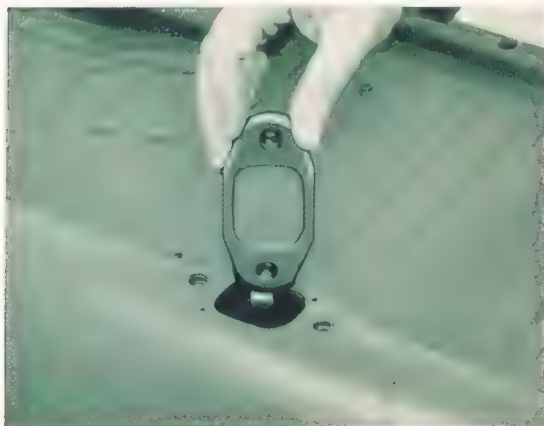


1 - Cut off the side corners of the guide to allow it to be inserted through the hole.

3 - Weld the guide at two points to the tunnel edge.



2 - Insert the guide and attach it to the tunnel by the two hex. screws.



4 - Grease the contact points of the shifting rod with Universal Grease VW — A 052.





### Underbody Care

A thorough care of the vehicle does not avoid damage to the underbody protective finish caused by flying stones. That is why each car should be inspected for damage once a year to make sure whether or not a touching up of the underbody finish is necessary.

- 1 - Thoroughly wash the car and allow it to dry. Remove any rust so that bare metal is exposed at the affected spots. Repair any other damage caused by flying stones.
- 2 - Examine brake lines and speedometer drive cable for damage and replace as found necessary.
- 3 - Touch up the finish and allow the paint to dry thoroughly before driving the vehicle.
- 4 - Underbody coating is now widely used and can be applied to Volkswagens. The work in preparation for spraying such protective coating is the same as detailed above (washing, drying, derusting). These compounds, which remain elastic in dry condition, can be used also for sealing any underbody leaks.

### Care of Chassis with Anti-Corrosion Oil

Underbody care with anti-corrosion oil requires attention to the following points:

- 1 - Spraying the underside of the vehicle can be limited to the cold season, when it is exposed to frost, moisture, snow and ice. For the rest of the year, such spraying is considered unnecessary.
- 2 - Use a proven anti-corrosion oil, but never deluted used oil, Diesel oil, or even kerosene.
- 3 - Apply anti-corrosion oil only after the vehicle has been washed thoroughly. When selecting oils, consideration should be given to the fact that some types of them can be applied with the underside still wet, while others can be used only when the parts to be treated are completely dry.
- 4 - When spraying, special care should be taken that rubber parts, especially brake hoses and seals, do not come into contact with the anti-corrosion oil. Oil or grease that may have dropped onto rubber parts should be removed as soon as possible. To spray an anti-corrosion oil, use spray guns for full wet coating rather than mist coating.



## 1 - VW Special Service Tools

VW 400	Repair Press 15 t
VW 401	Thrust Plate
VW 411	Punch
VW 412	Thrust Disc
VW 415	Tube, 75 mm dia.
VW 421	Tube, 28 mm dia.
VW 433	Thrust Pad
VW 435	Arbor

## 2 - VW Workshop Equipment for Local Manufacture

VW 670	Frame Head Assembly Jig
VW 671	Frame Alignment Gauge
VW 672	Frame Alignment Gauge

## 3 - Normal Hand Tools

Screwdriver, 6 mm  
Screwdriver, 8 mm  
Combination pliers  
Pipe wrench  
Cold chisel  
Cape chisel  
Prick punch (center punch)  
Punch, 2 mm  
Punch, 4 mm  
Mechanic's hammer, 300 grams  
Mechanic's hammer, 500 grams  
Triangular scraper  
Flat scraper  
Flat file, 180 mm in length  
Round file, 180 mm in length  
Half-round file, 180 mm in length  
Open-end wrench, 14 mm  
Open-end wrench, 17 mm  
Box wrench, 14 mm  
Box wrench, 17 mm  
Wire brush  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl  
Caliper square, 300 mm in length, measuring 1/50 mm  
Tap M 12 x 1.5  
Tap wrench, size 2, adjustable  
Die M 12 x 1.5  
Die stock, size 2  
Drill, 10.0 mm  
Drill, 12.0 mm  
Inspection lamp with cable and plug  
Electric drill

## 4 - Supplementary Workshop Equipment

Frame repair jig, VW 1025  
Spot welding plant  
Spot gun, 650 mm range  
Arc welding plant  
Portable Grinding Machine



## Contents:

- 1 - General Description and Construction**
- 2 - Body Removal and Installation**
- 3 - Fenders (Mudguards) and Sill Panels**
- 4 - Hoods (Bonnets)**
- 5 - Bumpers**
- 6 - Doors and Windows**
- 7 - Exterior Trim**
- 8 - Seats**
- 9 - Interior Trim**
- 10 - Sliding Roof**
- 11 - Top of Convertible**
- 12 - Special Hints**
  - A) Body Maintenance**
  - B) Care of Upholstery**
- 13 - Tools and Appliances**





# Body General Description and Construction



## General

The two-door all-steel body is bolted to the platform-type frame. The air resistance is exceptionally low due to the curved front hood (bonnet), the inclined windshield, the convex roof panel and the stepless, evenly sloping rear end. All fenders (mudguards) are detachable and can easily be replaced. Sill panels between the front and rear fenders add to the practical appearance of the car.

## Doors

The 950 mm (37.4") wide doors are attached to the body front pillars by hinges. The door locks are operated by pull-out type handles from the outside and by ordinary rotary-type handles from the inside. The left-hand door is locked from the outside, whereas the right-hand door is secured by raising the inside handle. The door fit in the body can be corrected by adjustable rubber buffers and door lock striker plates. The door check assembly allows the door to be opened 70°. A weatherstrip around the door prevents ingress of dust and water.

## Hoods (Bonnets)

To make spare wheel and luggage theft-proof, the front hood latch is operated by a pull-knob situated below the instrument panel on the left-hand side of the steering column. The rear hood lock is manually operated by turning the T-handle. A spring holds the hood in the open position.

## Windows

The undivided windshield inclines 30°. It offers an exceptionally wide field of vision. Defroster vents in the windshield frame bottom prevent condensation or freezing of moisture.

The window regulators require 3 1/4 turns for full travel of window. Vent wings in door windows permit draughtless control of fresh air; the spring-loaded pivot mechanisms hold the wings in any position required. The theft-proof wing locks are operated by handles and released by push buttons.

The rear side window glass panels are fixed. The oval rear view window has a slant of 53°.

All glass panels are of safety glass.

### Note:

Up to Chassis No. 1-454 950, the rear view windows is divided by a center bar and its glass panels are of plain plate glass.

## Seats

The backs of the adjustable front seats can be folded down. The seats of the De Luxe Model are held in seat runners, whereas those of the Standard Model are fixed by clamps and wing nuts. The coil springs are held in a tubular all-steel framework to which the paddings and upholstery are attached. Rubber hair paddings are used on the De Luxe Model.

The back of the bench-type seat can be folded down.

## Interior Trim

The floor is covered with rubber mats. Carpets are used to trim front panel, front side panels, lower side members, and, with the De Luxe Model, the frame tunnel and the luggage space behind the rear seat.

The door trim panels and the rear quarter trim panels are covered with upholstery cloth. With the De Luxe Model, they are provided with mouldings and kick pads at the base.

With the De Luxe Model, the hand brake lever is sealed at the frame by means of a rubber boot. Roof, roof side members, and the trim panel around the rear view window, are lined with cloth. The De Luxe Model is additionally provided with a door pocket on the driver's side and an armrest on the other side. A big built-in ash-tray is located in the right-hand rear quarter trim panel.

The rear view mirror — combined with a transparent sun vizor of tinted plastic in the De Luxe Model — is attached to the middle of the windshield frame.

The De Luxe Model is additionally provided with coat hangers and assist straps at the door lock pillars.

## Sound Deadening and Insulation

Cotton waddings are used to plug up the roof side members. To provide heat insulation and also to exclude any engine noise, the engine compartment partition panel is covered with a trim panel heavily coated with sound-absorbing material. The other side of the partition panel is coated with cork-felt. Sound transmission at the frame fork and the floor under the rear seats is dampened by a sound-absorbing material sprayed permanently in place. The front luggage compartment is lined with cork-felt. Layers of felt wadding are cemented to the roof, rear quarter panels and door outer panels to absorb noise and provide insulation.

## Heating

The interior of the car is heated by warm air. Warm air is guided through flexible metal pipes and the bottom side members of the body into the interior of the car through six openings, four ducts just above the floor and two defroster vents at the windshield.

## Luggage Accommodation

A luggage space behind the rear seat back is accessible by folding down the rear seat back. Another space for luggage accommodation is under the front hood.

## Exterior Trim

### a - Standard and De Luxe

The sill panels are covered with rubber mats. The width of the front and rear bumpers is 90 mm (3.54"). The height of the overriders amounts to 190 mm (7.5").

The headlamp rims are chrome-plated.

### b - Standard

Bumpers, overriders, hub caps, vent wing frames, door and hood handles, and the oval ring in front of the electrical horn are paint-coated.

### c - De Luxe

All the windows are framed with highly-polished mouldings, as are the waist line, sill panels and front hood. The front hood exposes a VW sign and the emblem of the town of Wolfsburg, where the Volkswagen is manufactured.

Bumpers, overriders, hub caps, vent wing frames, door and hood handles are chrome-plated. The two oval rings on the front fenders are of highly-polished aluminum.



# Body General Description and Construction

(From August 1955)



## General

The two-door all-steel body is bolted to the platform-type frame. A rubber strip is interposed to guard against ingress of dust and water. The air resistance is exceptionally low due to the curved and dropping front hood, the inclined windshield, the curved roofline, and the stepless, evenly sloping rear end. All fenders (mudguards) are detachable and can easily be replaced. Sill panels between the front and rear fenders add to the practical appearance of the car.

## Doors

The front-hinged doors offer a clear width of 950 mm (37.4"). From outside, the door locks are operated by pull-out handles and from inside by rotary handles. The left-hand door is provided with a cylinder lock incorporated in the outside handle, while the opposite door is locked from inside by pulling at the handle. The door check rod allows the door to be opened through an angle of 70°. A proper door fit is insured by a striker plate provided with a spring-loaded plastic wedge. A door weather strip of sponge rubber with a short lip provides a seal between body opening and door.

## Hoods (Bonnets)

The front hood, giving access to fuel tank, spare wheel, and front luggage space, is provided with a lock that is released by a pull knob under the instrument panel on the driver's side. The hood is held open by an automatically engaging collapsible prop. The top-hinged engine compartment hood is unlocked manually by means of a T-handle. A strong balance spring holds the hood in the open position.

## Windows

The undivided windshield inclines 30°. It offers an exceptionally wide field of vision. Defroster vents in the windshield frame bottom prevent condensation or freezing of moisture.

The window regulators require 3<sup>1</sup>/<sub>4</sub> turns of the handle for full travel of window. Vent wings in door windows permit draughtless control of fresh air; the frictional pivot mechanisms hold the wings in any position required. The theft-proof wing locks are operated by handles and released by push buttons.

The rear quarter window glass panels are fixed. The oval rear view window has a slant of 53°.

All glass panels are of heat-treated safety glass.

The windshield is provided with a clear vision area.

## Front Seats

The seats of the De Luxe Model are held in slanting seat runners, whereas those of the Standard Model are fixed by clamps and wing nuts. On the De Luxe Model, the rake of the front seat backrests can be set at three positions. The coil spring base of the cushion and the corrugated springs of the backrest are held in a tubular steel framework. Rubber hair paddings are used on the De Luxe Model, the backrest edges are "piped" for increased lateral support.

## Rear Seats

The tip-forward backrest of the rear seat bench is held in place by a detachable strap to avoid the luggage tumbling into the passenger compartment when the brakes are applied.

## Interior Trim

The floor, the lower portion of the front panel, and the frame tunnel, are covered with rubber mats. On the Standard Model, the frame tunnel rubber matting is interrupted over a length extending from the gear lever to the rear edge of the front seats.

Haircord carpets are used to trim front panel, front side panels, body side members (sills), and, on the De Luxe Model, the luggage space behind the rear seat. Roof and, on the De Luxe Model, roof side members and the inner panel around the rear window, are lined with cloth.



Door and rear quarter trim panels are covered with upholstery cloth. On the De Luxe, the trim panels are supplemented by washable plastic material and mouldings at the waistline level; door trim panels have kick pads at the base, a pocket on the driver's side, and an armrest for the front passenger. The right-hand rear quarter panel carries a pull-out ash receiver.

The hand brake lever is sealed at the frame tunnel by a rubber boot.

Additional items on the De Luxe are coat hangers and assist straps at the door lock pillars.

The rear view mirror — combined with a transparent sun vizor of tinted plastic in the De Luxe — is attached to the center of the windshield frame upper side; the mirror is adjustable in a ball joint.

## Sound Deadening and Insulation

Cotton waddings are used to plug up the roof side members. To provide heat insulation and to exclude any engine noise, the engine compartment partition panel and the wheel arches are lined with sound deadener. The inner side of the partition panel is coated with cork-felt. Sound transmission at the frame fork and at the floor under the rear seats is dampened by sprayed-on sound-absorbing material. On the De Luxe, also the frame tunnel has a coat of sound deadener. The front scuttle is lined with cork-felt. Layers of felt wadding are cemented to the roof, rear quarter panels, and door outer panels, to absorb noise and provide insulation.

## Heating

Heated air, which is taken from the air flow warmed up by the engine, is guided through flexible metal pipes and the bottom side members (sills) of the body into the interior of the car through outlets at foot level in the front compartment and two defroster vents at the windshield.

## Luggage Accommodation

Luggage space is provided behind the rear seat, which has its backrest hinged to facilitate loading. Another luggage space is under the front hood.

## Exterior Trim

### a - Standard and De Luxe

The sill panels are rubber-covered. The width of front and rear bumpers is 90 mm (3.54"). The height of the overriders amounts to 190 mm (7.5"). Headlamp rims are chrome-plated. The VW sign is indented in the hub cap.

### b - Standard

Bumpers, overriders, hub caps, vent wing frames, door, window and hood handles, and the oval ring in front of the electrical horn are paint-coated.

### c - De Luxe

The mouldings on front hood, at body waist line and on door sill panels are of highly-polished light metal, as are the window mouldings and the ornamental rings on the front fenders.

Bumpers, overriders, hub caps, vent wing frames, door, window and hood handles are chrome-plated.

The front hood exposes a VW sign and the emblem of the town of Wolfsburg, where the Volkswagen is manufactured.

## Sliding Roof

The sliding roof, make Golde, has a clear length of 690 mm (27.2") and a clear width of 730 mm (28.7") when fully opened. It can be locked in any open position desired.



# Body General Description and Construction

(Karmann-Ghia Coupé)



## General

The two-door all-steel body, having the sweeping lines of a pontoon, is bolted to the widened platform-type frame. Strong body sills below the doors provide maximum rigidity in conjunction with the tubular backbone and the platform. The fenders are welded to the body.

## Doors

The doors are constructed as half doors without an upper frame and are 1000 mm wide (39.4"). The vertically curved door windows, when closed, come to bear directly against weatherstrips around the body opening.

The forward-hinged doors have a press-button handle and a hold-open mechanism. From inside, the doors are opened by means of handles placed well to the front. The armrest on the passenger's side is designed to serve also as a handle for closing the door, while the driver's door is provided with a hand strap.

## Hoods (Bonnets)

Access to fuel tank, spare wheel, front luggage space, and the engine is provided by a rear-hinged hood, the lock of which is released by pulling at a knob located inside the car. The knob for the front hood is located on the driver's side under the instrument panel. When hood lock is released, the hood can be raised after the safety catch has been pushed back. The engine compartment hood is unlocked by means of a knob located on the vertical panel below the bench seat. The license plate light fitting serves as a handle for lifting the hood. Both hoods are held open by counter-balancing springs.

## Windows

The curved windshield is set at an angle of 50 degrees and offers a clear space of 1.200 mm (47.2") in width and 425 mm (16.7") in height. The large wrap-around rear window inclines approx. 30 degrees, the clear space amounting to 1.100 mm (43.4") in width and 430 mm (16.9") in height. Door windows and rear quarter windows are curved to the vertical contour of the body. The door windows can be wound down, the rear quarter windows are fixed. Both front and rear occupants have an exceptionally good all-round view thanks to the slender pillars and the narrow side window division bars.

All windows are of safety-glass and the windshield is provided with a clear vision area.

## Seats

The wide front seats with hinged backrests are adjustable forward and backward. The seats rise as they move forward, permitting short persons to sit higher. The framework of the seats is of tubular steel, while the base of the cushion and the backrest are of coil springs covered by rubber hair paddings. The horseshoe-shaped edges of the cushions and the vertical edges of the backrests are "piped" to provide a good lateral support.

In the back of the car are two children's or emergency seats of the bench type. These seats are also covered with rubber hair paddings. The backrest can be folded forward to add to the luggage platform area.

## Instrument Panel

The two circular instruments are set directly in front of the driver. To the left of the electric clock is the speedometer, the dial of which includes the various warning lights. Both instruments have a diameter of 110 mm (4.3"). Space for radio installation is provided in the center of the panel. An ash receiver and a glove compartment with lid are in front of the passenger's seat. Ignition switch and choke control knob are located to the left of the speedometer, and the push-pull type lighting and windshield wiper switches to the right of the clock.

## Interior Trim

Depending on the choice of the customer, either cloth or leather is used to upholster the seats and door trim panels. The floor is covered with rubber mats. Haircord carpets are used to trim kick panels and the luggage compartment in the back of the car. Each door is equipped with a pocket. The rear view mirror above the windshield is flanked by two sun vizors. Mounted on top of the instrument panel is a grab rail for the front seat passenger.

## Heating and Ventilators

The heating system is identical with that used on the VW Passenger Car. The amount of heated air emitted through the openings at foot level and the windshield defrosters is controlled by means of the rotary knob on the frame tunnel. To ventilate the interior, fresh air enters the two openings adjacent to the headlights and is directed to the defroster vents at the windshield. Rotary knobs below the instrument panel allow a separate control of the two ventilators. This arrangement makes it possible to have either heated air or fresh air emitted through the defroster vents or both in the desired proportion.

## Luggage Space

The luggage space is to be found behind the rear backrest and under the front hood. The space available in the rear is about 0.18 cbm. By pushing the backrest forward the space is augmented by 0.2 cbm. In the front there is about 0.08 cbm space available.

## Exterior Trim

The main features of the exterior trim are:

Chrome-plated wrap-around bumpers with sturdy overriders.

Rims of headlights, direction indicator lights and tail lights are chrome-plated. Mouldings on side panels at bumper level, glass frames and air intake grilles at front are of polished light weight metal.

Chrome-plated door handles.

Chrome-plated tail pipes.

Chrome-plated rim embellishers and hub caps.



## Body Removal and Installation

### Removal

To facilitate the removal and installation of the body, it is recommended to adopt the following sequence of operations:

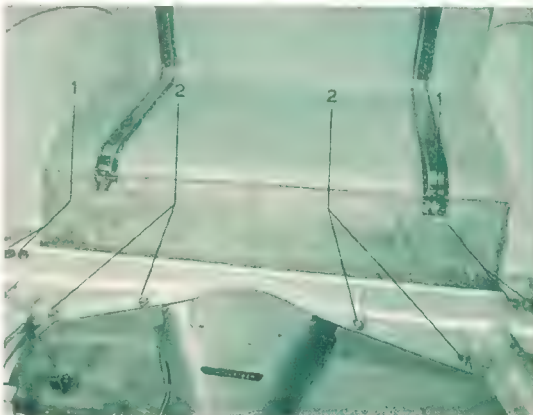
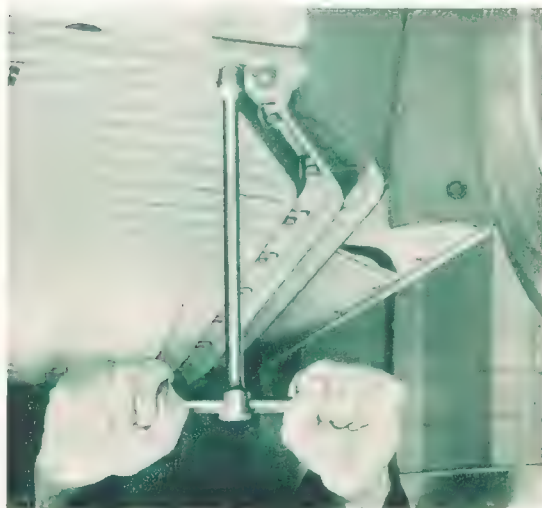
- 1 - Place car on trestles.
- 2 - Remove wheels.
- 3 - Remove front and rear seats.
- 4 - Disconnect battery and close fuel tap.
- 5 - Disconnect speedometer drive shaft from left-hand front wheel hub.
- 6 - Detach fuel hose from fuel tap.
- 7 - Remove cotter pin between operating rod and fuel tap and remove operating rod.
- 8 - Remove fuel tank.
- 9 - Disconnect choke control cable from instrument panel and withdraw it from the body.
- 10 - Detach steering column and withdraw it together with the steering wheel.
- 11 - Disconnect cable from stoplight switch and withdraw it to the spare wheel compartment.
- 12 - Pull off heating pipes after having released the clips.
- 13 - Detach starting motor cable and cables 30 and 50 from starting motor.
- 14 - Disconnect cables 51 and 61 from the generator and cable 15 from the ignition coil. Also detach cable from oil pressure control switch.
- 15 - Remove the 18 body bolts (metric 8 mm).
- 16 - Remove the 4 bolts (metric 10 mm) at the front crossmember.

- 17 - Remove the bolts located at the rear quarter panel reinforcement, one on each side.



- 18 - Remove the 4 bolts (metric 10 mm) that attach the body to the rear cross tube.

- 19 - Remove the 4 bolts (metric 8 mm) at the rear crossmember.



- 1 - Body attachment at rear cross tube.
- 2 - Body attachment at rear crossmember.

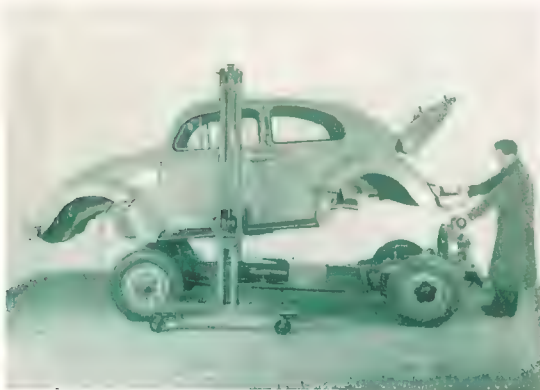
- 20 - Remove the two bolts (metric 10 mm) that attach the body to the front axle.



**Note:**

If it is intended to lift off the body by means of the gantry VW 301, reinstall the wheels and lower the car to the floor.

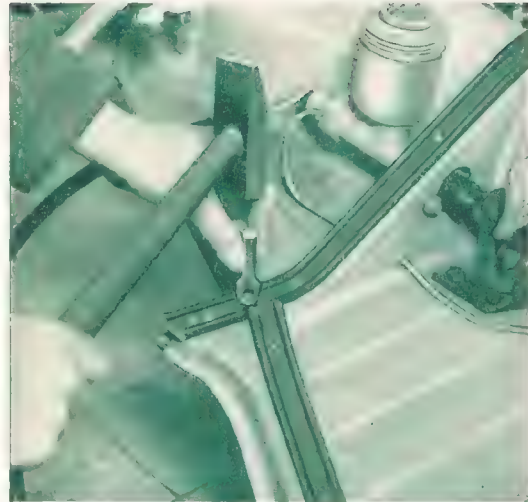
- 21 - Lift the body from the chassis and withdraw the chassis.



**Installation**

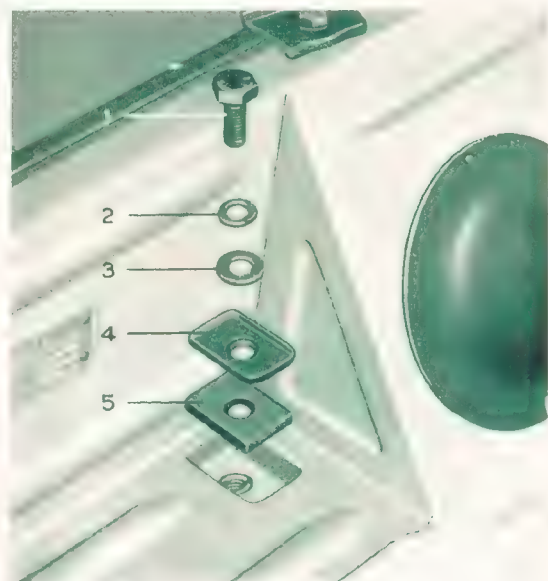
This is a reversal of the operations described above, but attention should be paid to the points below:

- 1 - Renew weather strip between body and frame. Tack the weather strip to the frame, using 36 tacks, and connect the ends at the corners by means of a stapler.
- 2 - Punch the weather strip with a 10 mm (.8") punch above the 4 holes in the front cross-member.



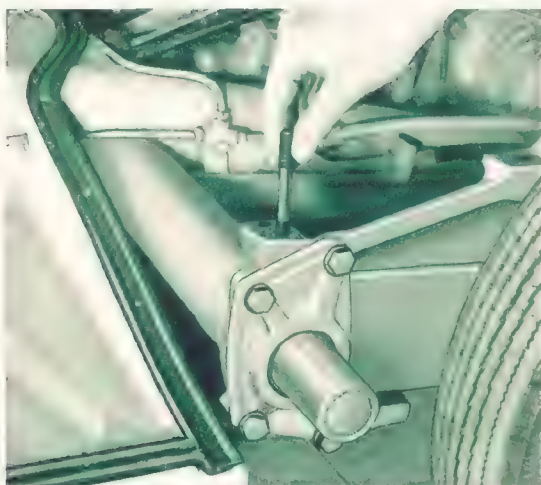
- 3 - Fill the gaps at the corners and the depression in the weather strip with Genuine VW Sealing Compound D 8. Prevent the weather strip from moving out of place when lowering the body into position and when inserting the body mounting bolts. If necessary, cement the weather strip into place.

- 4 - Place rubber packings on front axle and rear cross tube.



- |                    |                 |
|--------------------|-----------------|
| 1 - Mounting bolt  | 3 - Washer      |
| 2 - Lockring       | 4 - Metal plate |
| 5 - Rubber packing |                 |

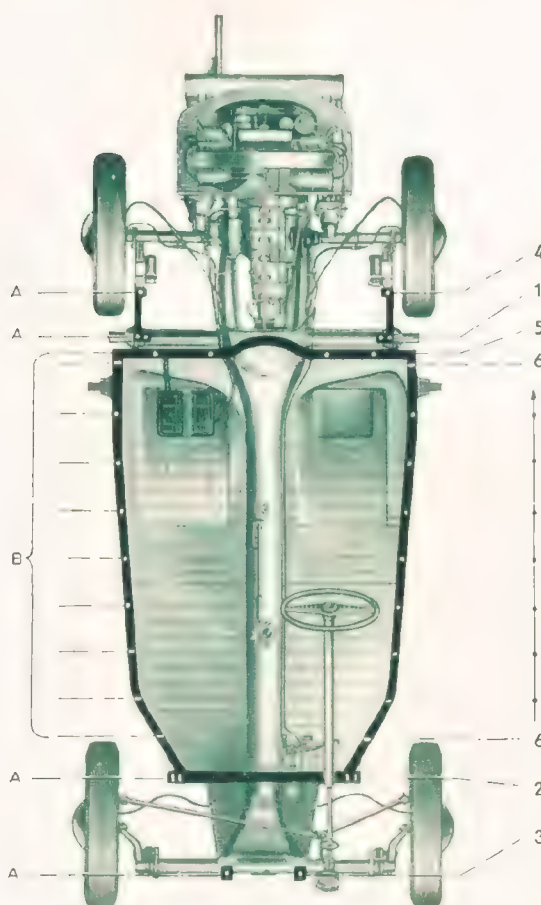
- 5 - To guide the body into place, it is recommended to screw studs into the holes at rear cross tube. Remove these studs after the body drop.



Note position of battery copper braid (ground). The bolts to be inserted through the front cross-member are screwed into a plate provided with two tapped holes. These plates are freely moving in metal guides which are welded to the body.

**Note.** — Should it be found that the heads of the front bolts M 8 do not sufficiently cover the slotted holes, it is recommended to fit locally-made rubber shims between body and frame to insure a perfect sealing.

6 - First lightly tighten all bolts M 10 and then all bolts M 8 opposite in turn in the below illustrated order.



A = Bolts M 10  
B = Bolts M 8

7 - A possible gap at the mounting bolts on the front axle should be compensated by two rubber packings. The gap should never exceed 3 mm (.12").

8 - Tighten all body mounting bolts to the following torques, using torque wrench VW 118:

Bolts M 10 ..... 3 mkg (22 ft. lbs)

Bolts M 8 ..... 2 mkg (14 ft. lbs)

9 - Install steering column, using a new clamp screw lock plate.

10 - Place upper lip of engine weather strip over the cover plate.

11 - Connect the battery and open the fuel tap.





# Body

(Karmann-Ghia Coupé)



## Repair Hints

The exchangeability of the sheet metal parts is indicated by the drawings to assist in repairing the outer body shell. The parts marked with capital letters (A, B, C) constitute the outer body shell and are listed below with the corresponding part numbers. The weld seams indicated by heavy black lines show the outline of the spare parts, while those indicated by thinner lines show all further weld joints of the outer body shell.

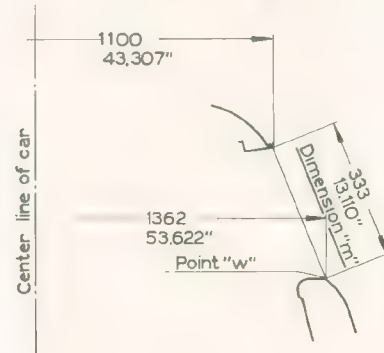
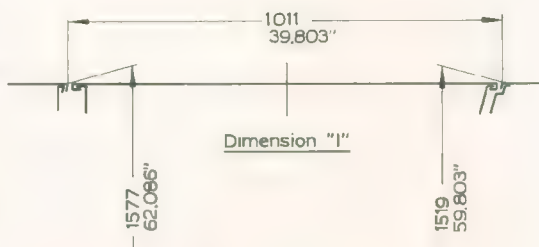
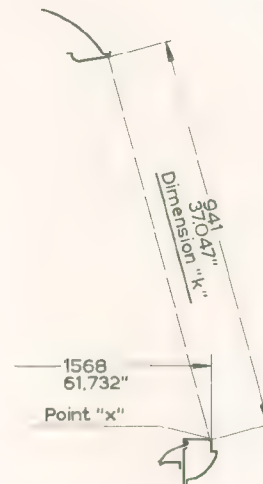
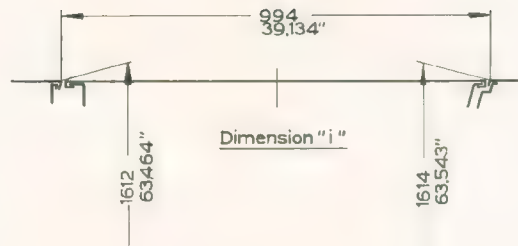
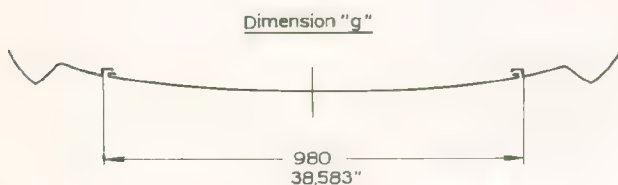
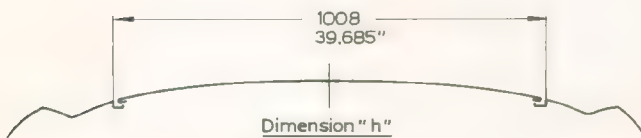
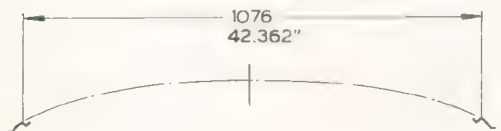
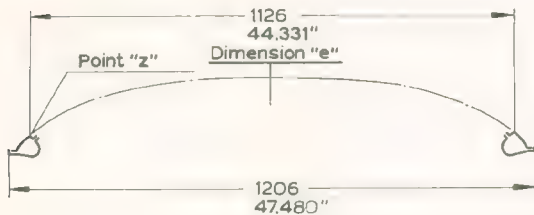
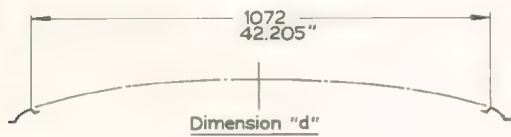
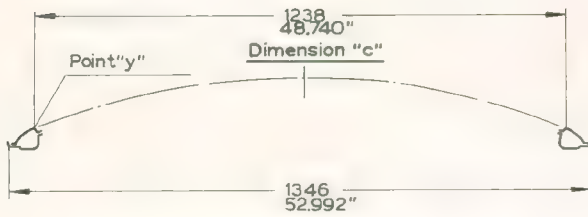
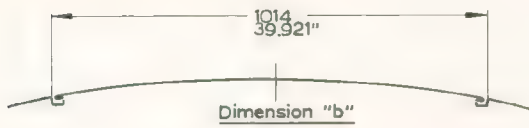
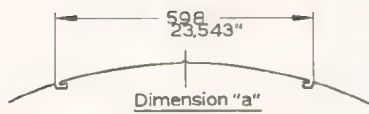
Templates should be made in accordance with the drawings, using the dimensions as a guide. To obtain an accurate conformity of the templates with the shape of the body, these should be adapted to a new car.

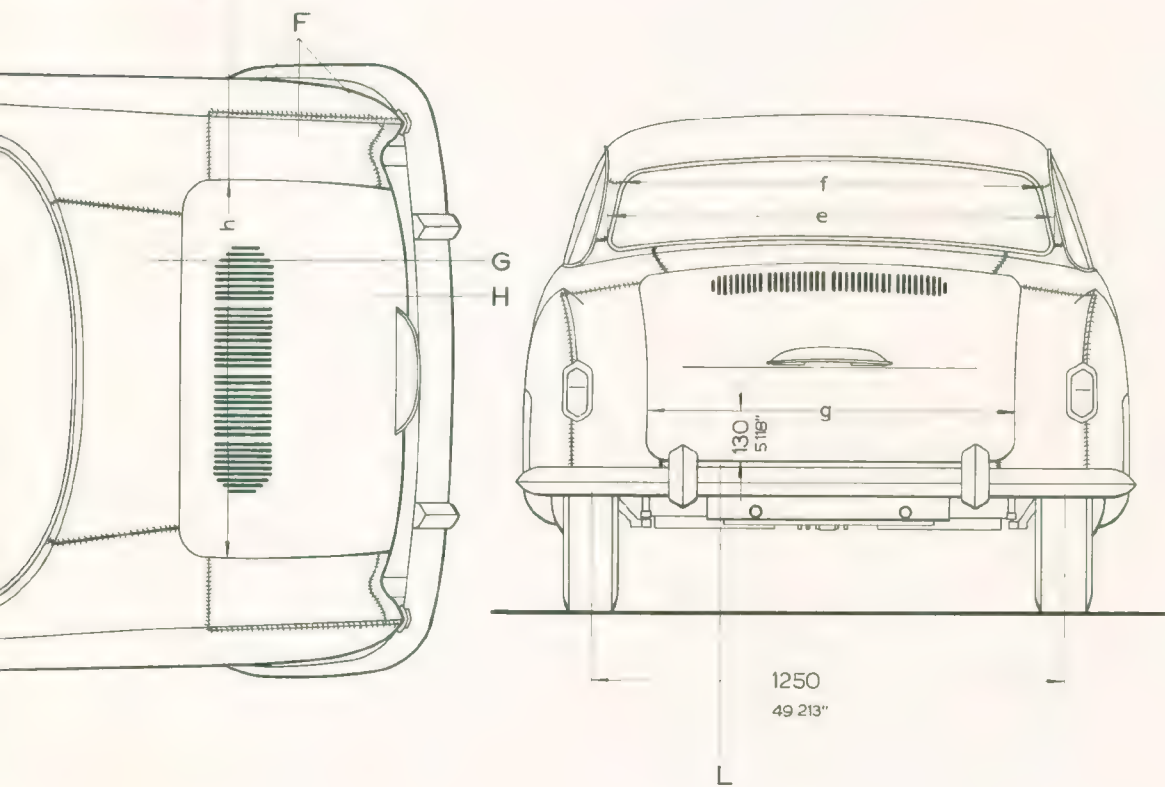
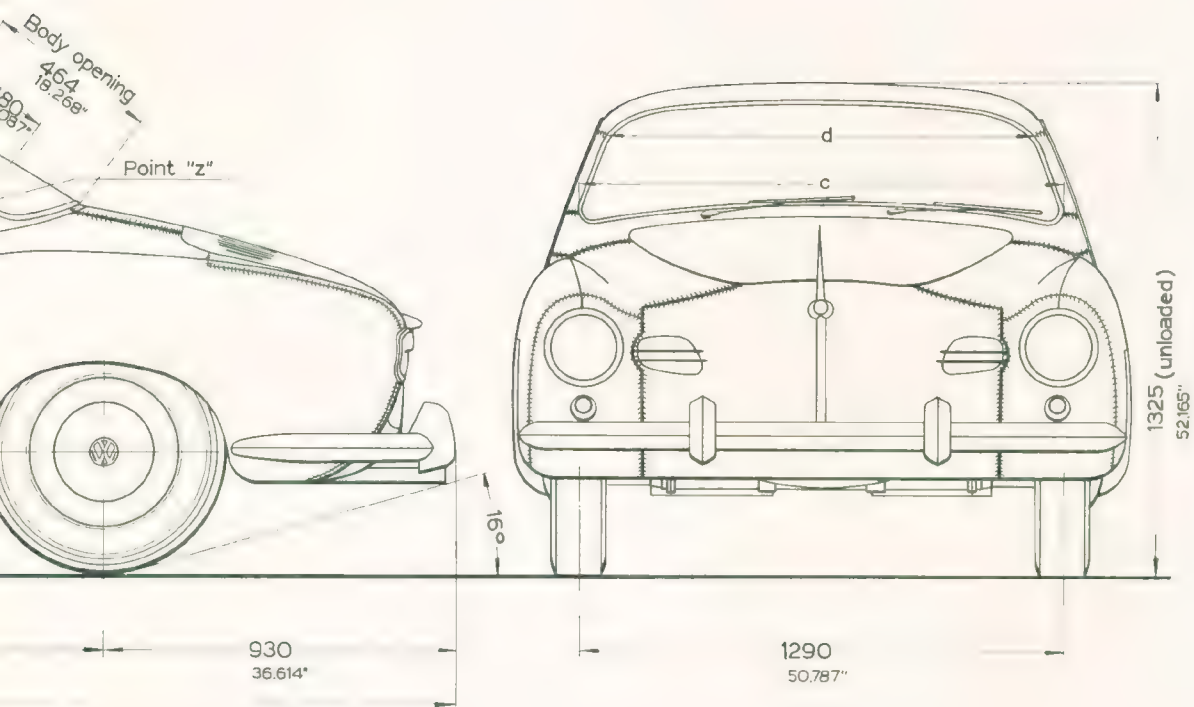
The drawings show the

- individual parts of the body shell,
- the spare parts,
- all weld seams,
- body dimensions, and
- points of reference for measuring.

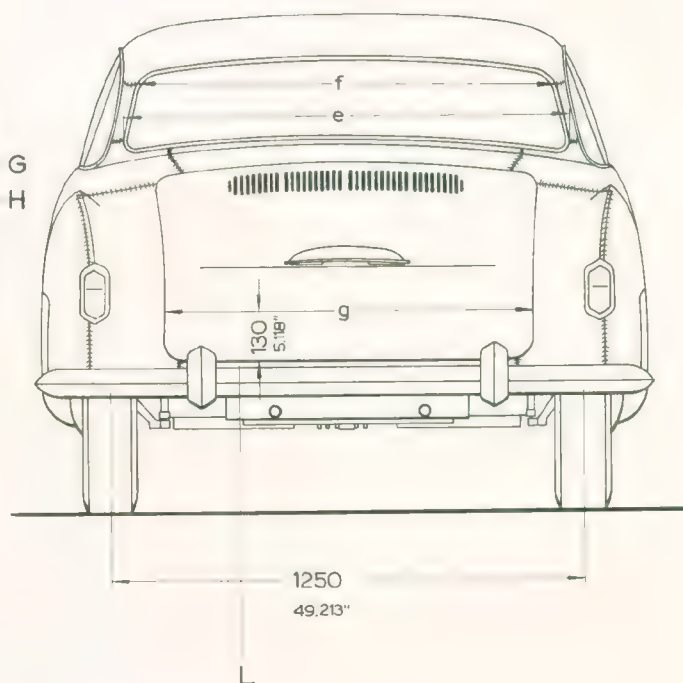
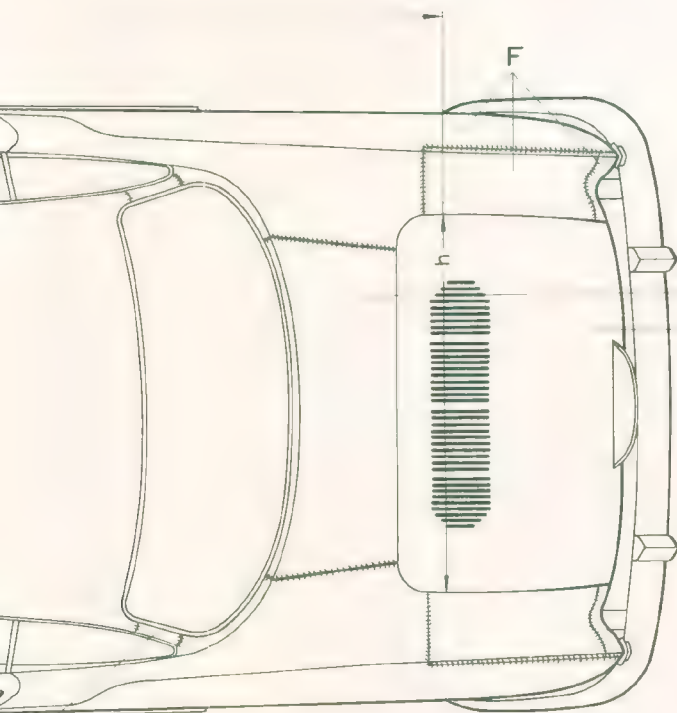
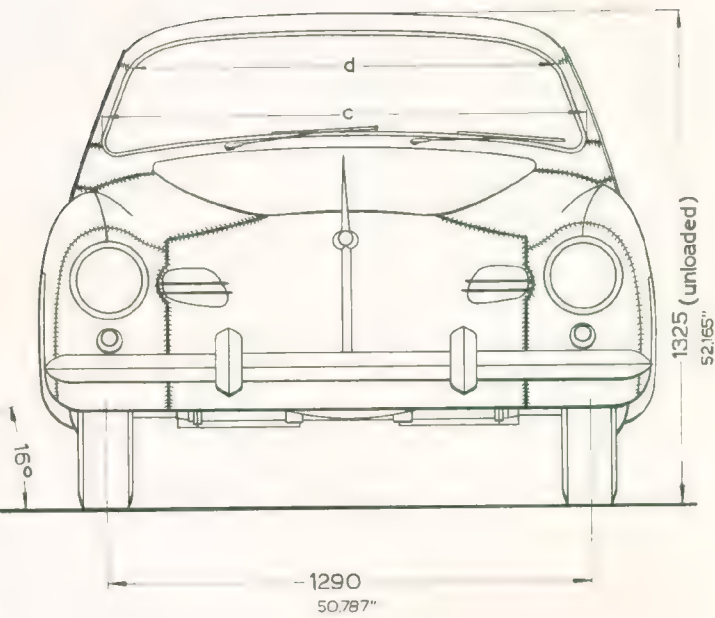
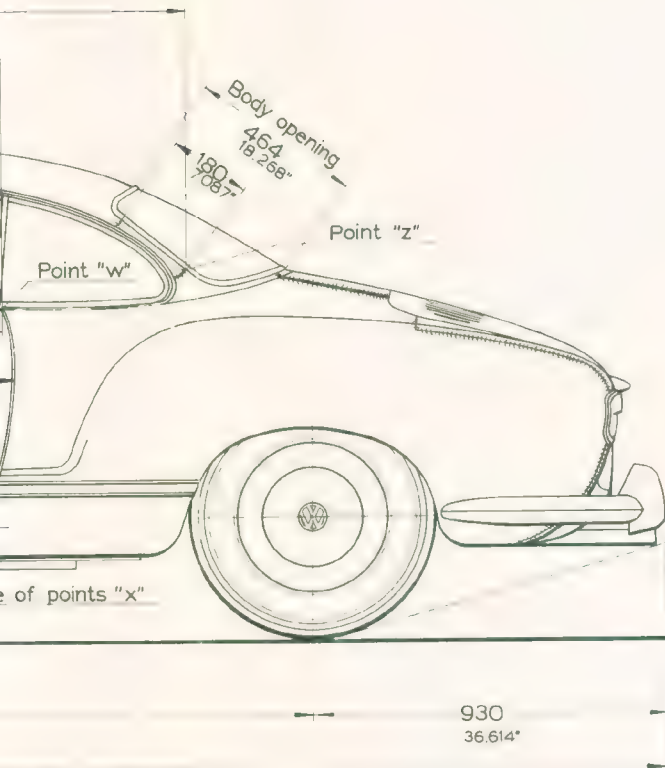
## Parts List

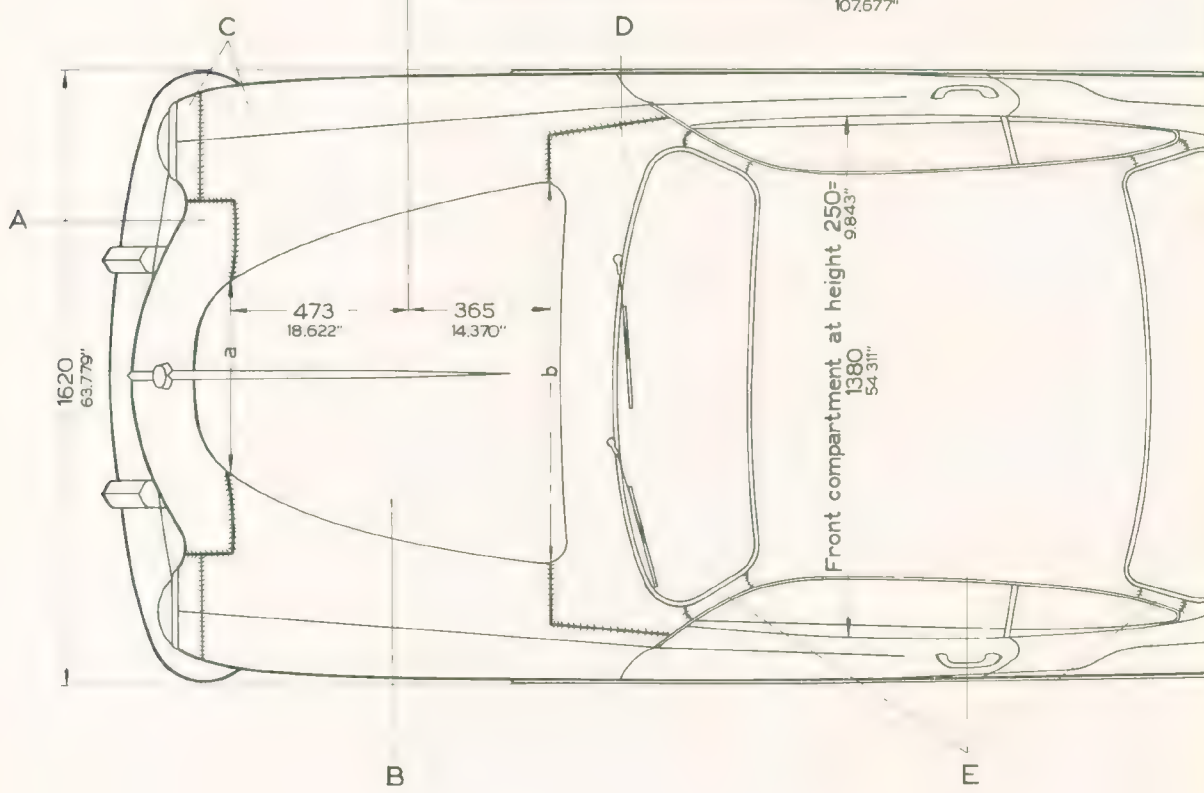
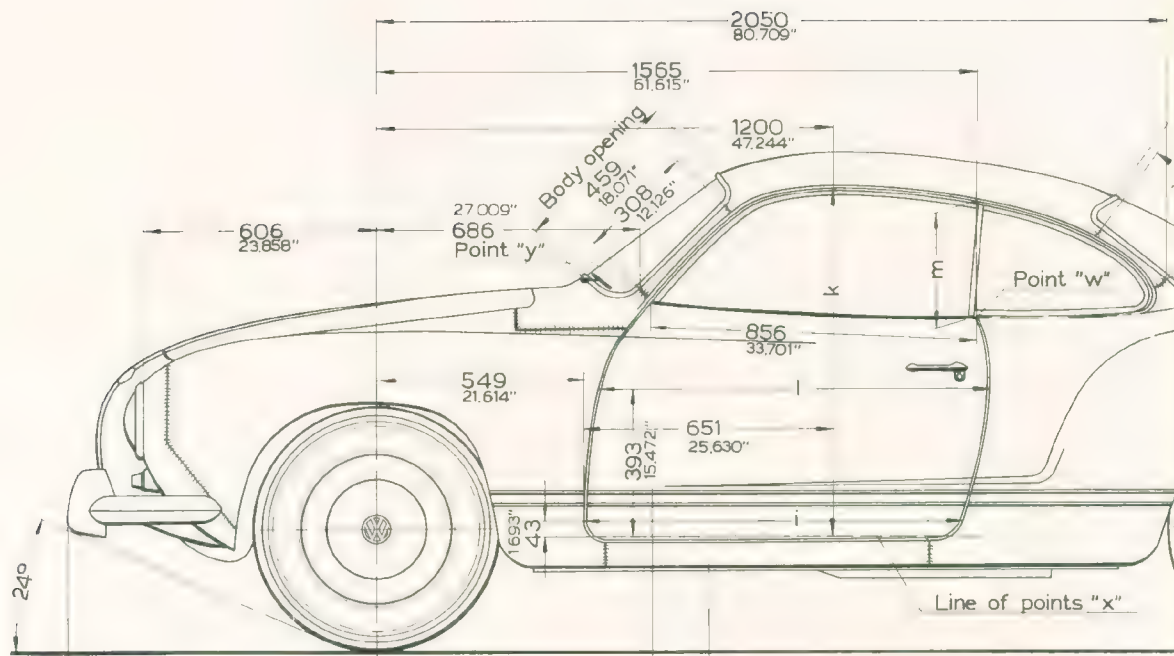
Letter	Description of Part	Part No.
A	Front panel	141 805 065
B	Front hood	141 823 031
C	Side panel, front, left	143 809 021
	Side panel, front, right	143 809 022
D	Cowl panel	443 805 095
E	Roof	143 817 021
F	Side panel, rear, left	143 809 085
	Side panel, rear, right	143 809 086
G	Deck panel	143 813 131
H	Rear hood	141 827 025
I	Door shell, left	141 831 051
	Door shell, right	141 831 052
K	Sill panel, left	143 801 025 A
	Sill panel, right	143 801 026 A
L	Rear apron	141 813 301











## Front Fender Removal and Installation

### Removal

- 1 - Place front end of car on a trestle and remove front wheel.
- 2 - Remove headlamp.
- 3 - Remove retaining screws of headlamp housing support.



- 4 - Remove the 9 fender mounting bolts and the bolt between fender and sill panel.



- 5 - Take off fender and beading.

### Installation

Reverse the removal procedure and observe the following points:

- 1 - Check condition of fender beading, replace if necessary. Note correct position of beading when installing the fender.
- 2 - If necessary, recut the threads of the holes for the fender mounting bolts. Grease the bolt.
- 3 - If necessary, replace rubber washer between fender and still panel.
- 4 - Aim the headlights.
- 5 - Tighten wheel mounting bolts to a torque of between 9 and 11 mkg (65 and 80 ft. lbs.).

## Rear Fender Removal and Installation

### Removal

- 1 - Place rear end of car on a trestle and remove rear wheel.
- 2 - Remove tail and stop light casing, rubber seal and lamp holder from fender, and disconnect cable. Withdraw the cable from the fender.
- 3 - Pull out bumper bracket after having removed the bolts and nuts under the fender and at the bumper. Take off the rubber grommet.
- 4 - Remove the ten fender mounting bolts and the bolt between fender and sill panel.
- 5 - Take off fender and beading.

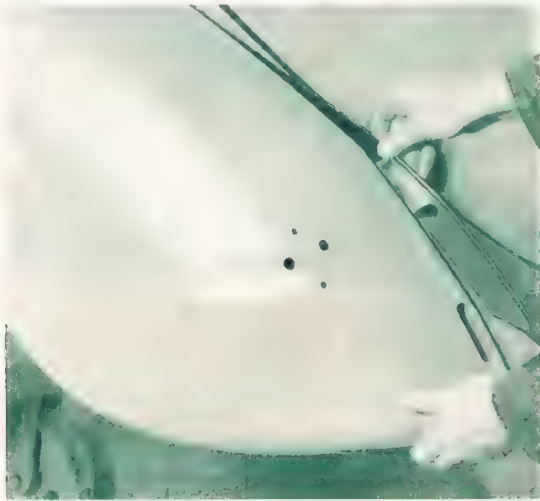




### Installation

This is a reversal of the above operations, but it is important to observe the following points:

- 1 - Check condition of fender beading, replace if necessary. Note correct position of beading when installing the fender.



- 2 - If necessary, recut the threads of the holes for the fender mounting bolts. Grease the bolts.

- 3 - If necessary, replace rubber washer between fender and sill panel.

- 4 - Press bumper bracket grommet into the slot in the fender. Insert bumper bracket from the rear and screw it into place.



- 5 - Note proper position of rubber seal between lamp casing and fender, renew rubber seal if this should be considered necessary.

- 6 - Tighten wheel mounting bolts to a torque of between 9 and 11 mkg (65 and 80 ft. lbs.).

## Sill Panel Removal and Installation

### Removal

- 1 - Remove the bolts and nuts that attach the sill panel to the front and rear fenders.
- 2 - Loosen the four bolts that attach the sill panel to the body.
- 3 - Remove sill panel by lifting it upwards.

### Installation

- 1 - Reinstall the sill panel so that the slots embrace the mounting bolts.
- 2 - Tighten the four mounting bolts.
- 3 - Tighten the two mounting bolts at the fenders.



## Front Hood Removal and Installation

### Removal

- 1 - Open the hood.
- 2 - Remove two bolts from each hood hinge.
- 3 - Support the hood with one hand and screw out the upper bolt of the collapsible bracket.
- 1 - Check condition of weather seal. If necessary, bend up the retaining flange and replace the weather strip.
- 2 - Loosely attach the hood to the hinges and adjust hood in the slotted holes until a perfect hood alignment is obtained. Tighten the hinge bolts.



- 4 - Remove the other hood hinge bolts.
- 5 - Take off the hood.
- 6 - If required, remove the rear hinge bolts and take off the hinges; remove the hood lock bolt assembly, moulding, emblem and VW sign.
- 3 - Check latch plate assembly for proper functioning by closing and opening the hood several times. If necessary, adjust position of the latch plate assembly by moving it in its slotted holes. Grease the lock.

### Note:

From Chassis No. 1-0 929 746 the front hood and its prop have been modified.

The welded-in nut used for fixing the prop to the hood has been omitted. The prop is now attached to the front hinge bolt.

The new hood can be installed on earlier cars only in conjunction with the new prop.

Old type hoods and props have been discontinued in current production.

### Installation

Reverse the removal procedure, while observing the following points:

## Front Hood Lock Removal and Installation

### Removal

- 1 - Open the front hood.
- 2 - Remove the two retaining screws of the lock bolt bracket and take off handle and lock bolt assembly.
- 3 - Remove the mounting bolts and nuts of the latch plate assembly.



4 - Pull off latch plate assembly cover plate.

5 - Pull out the hood lock cable after having loosened the clamping screw.

6 - Pull out the hood lock cable from the conduit tube.



3 - Loosely attach latch plate assembly to the front apron of the body.

4 - Install hood handle and lock bolt assembly.



#### Installation

1 - Grease the hood lock cable and insert it into the conduit tube.

2 - Insert the cable end into the latch plate assembly and fix it in position by tightening the clamping screw. Bend down the projecting cable end.



5 - Check length of lock bolt and proper position of latch plate assembly by opening and closing the hood several times. If required, correct the length of the lock bolt at the adjusting nuts and adjust latch plate assembly by moving it in its slotted holes.

6 - Check adjustment of hood lock cable. If necessary, adjust the cable after having removed the cover plate.





7 - Fully tighten latch plate assembly mounting bolts.

8 - Grease lock bolt.

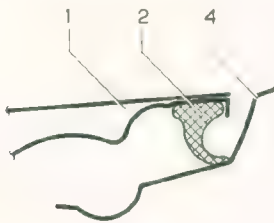
**Note:**

The condition of a sticking latch plate can generally be eliminated by applying a light hammer blow on the lower latch plate guide while keeping the latch plate in the foremost position.

## Ingress of Water at Front Hood

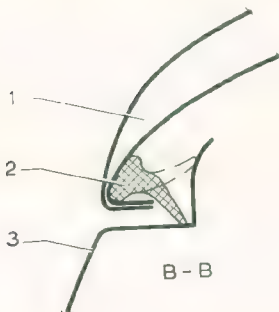
When driving at high speed in heavy rain, water may enter the body at the point indicated by the arrow.

A remedy is effected by installing a special rubber strip (Part No. 111 823 707 A), using Genuine VW Adhesive D 12 to secure it in position.

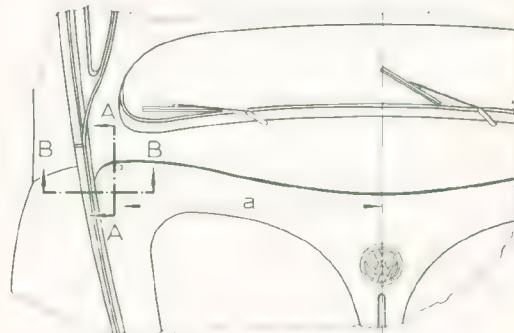
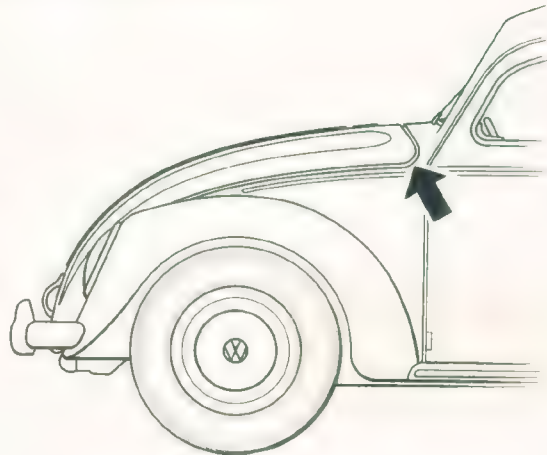


A - A

- 1 - Front hood
- 2 - Rubber strip
- 3 - Front side panel
- 4 - Roof



B - B



$$a = 532 \text{ mm (20.945")}$$

The proper location of the rubber strip and the position of its lip is as shown on the drawings.

Should the lip turn upwards as indicated by the dotted line in section B-B, it is to be shortened appropriately.

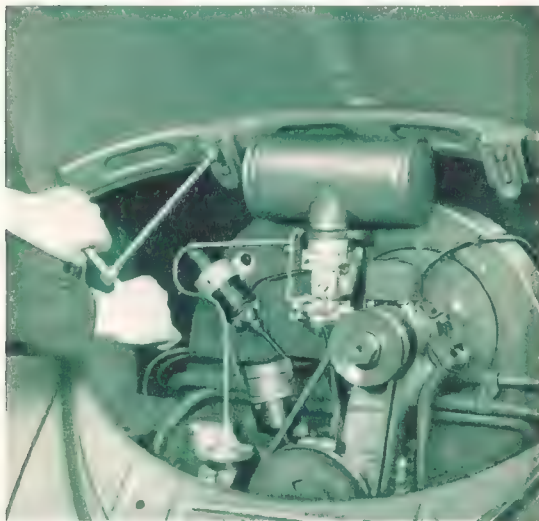
## Rear Hood Removal and Installation

### Removal

- 1 - Lift the rear hood.
- 2 - Bend up the cable clips at the license plate light cable and remove the lamp housing and rubber seal.



- 3 - Loosen the two hinge bolts on each side. If required, loosen hinge bracket bolts.



- 4 - Unhook the counterbalancing spring from the hood bracket by compressing the two ends.

Support the hood and unhook the spring from the body bracket.



- 5 - Remove hood hinge bolts or hinge bracket bolts and take off the hood.
- 6 - If required, remove the hood lock.

### Installation

Installation is a reversal of the above procedure, but the following points should be heeded:

- 1 - Check condition of weather strip. If necessary bend up the retaining flange and replace the weather strip.
- 2 - Bolt the hood loosely into place and put the counterbalancing spring in the intermediate slot of the body bracket.

#### Note:

The tension of a weak spring is increased by placing it in the lower slot.

- 3 - Make sure that the hood alignment is perfect. The slotted holes at the hinges permit an adjustment. Tighten the hinge bolts.
- 4 - Note correct position of the license plate lamp seal.

#### Note:

From Chassis No. 869 851 the rear hood and spring has been altered. This spring is stronger and the windings are further apart.

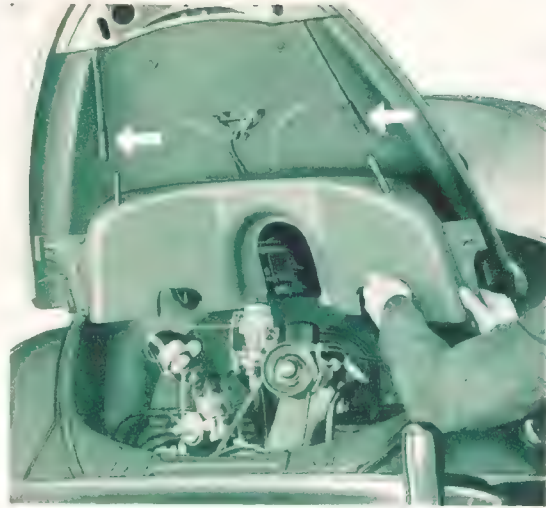
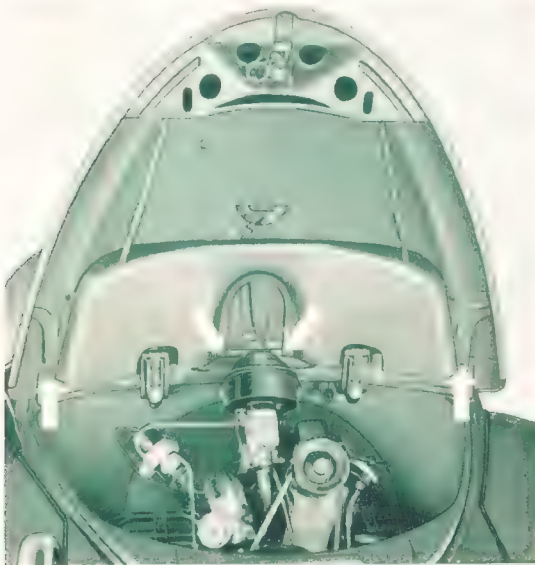
As earlier hoods and springs are not interchangeable with the new ones, they will continue to be available as spare parts.

## Rear Hood (from August 1957)

To improve the sealing of the engine compartment against ingress of water and the mounting and illumination of the license plate, the rear hood has been altered.

The air intake slots in the rear hood of the Convertible are now horizontally positioned. Any water getting through these slots flows via a tray, mounted under the hood, and two drain pipes to the lower edge of the hood where it is disposed of outside the weather strip.

If it becomes necessary to remove the tray, remove the four self-tapping screws after having taken off the air cleaner.



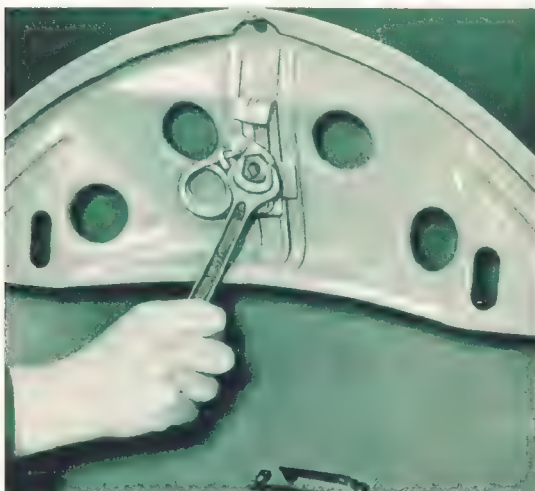
When removing the tray the two drain pipes must be pulled out of the two rubber sleeves.

When installing, it is important that the rubber buffers are properly seated to prevent rattling. Replace damaged rubber buffers.

Removal and installation of the rear hoods of Sedans and Convertibles is carried out as before.

As hoods of earlier types are not interchangeable with the new ones, they will continue to be available as spare parts.

## Rear Hood Lock Removal and Installation



### Removal

- 1 - Lift the rear hood.
- 2 - Remove retaining nut from inside of hood.



3 - Hold the lock and pull out handle and escutcheon.



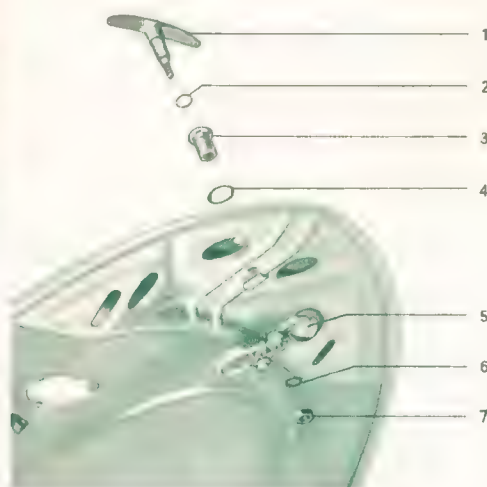
#### Installation

Installation is accomplished by reversing the removal procedure, but the following points should be observed:

1 - Check condition of gaskets and replace as required.

2 - Position hood lock in the guide on the inside of the hood and insert complete handle from the top.

3 - Do not overtighten the nut, allowing a free movement of the lock.



1 - Hood handle  
2 - Gasket  
3 - Escutcheon

4 - Gasket  
5 - Hood lock  
6 - Lock plate  
7 - Nut

## Rear Hood Weatherstrip

In cases where the weatherstrip lip does not make perfect contact with the rear hood, exhaust fumes are likely to pass into the engine compartment and thence into the interior of the Coupé when the heating is turned on.

From Chassis No. 998 255 onward, a weatherstrip with reinforced lip is used in current production which renders any ingress of exhaust fumes impossible. This weatherstrip, obtainable under Part No. 141 827 705, should be installed if found necessary.

In any case, the sealing of the weatherstrip lip against the hood should be checked. The sealing is perfect, if French chalk, spread along the hood gap at high engine speed, does not enter the engine compartment.

In this connection it is good practice to pull out the exhaust tail pipes to a length of 200 mm (7.9") as measured from their clamps; the standard length is about 170 mm (6.7"). Thus the air around the hood will be less contaminated with exhaust fumes.

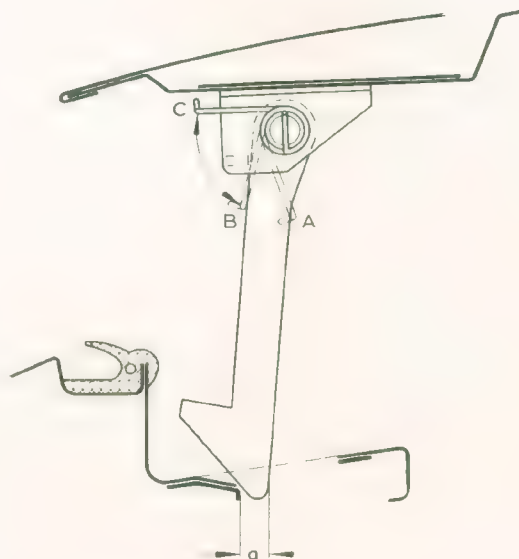
## Front Hood Safety Hook

Compliance with the following conditions will provide sufficient safety against an accidental opening of the front hood:

When the safety hook (Spare Part No. 141 823 485) is placed on the lock carrier, the distance between the front edge of the opening and the rear side of the hook is not to exceed a maximum of 7 mm (a).

Whenever this maximum is exceeded, the spring must be given a greater initial tension. This is done as follows:

- a - Lift the spring (A) off the hook, thus relieving the tension (B).
- b - Bend the spring upward until it is in a horizontal position, thus providing increased tension (C).
- c - Cock the spring again and place it behind the safety hook (A).



### Attention!

If in spite of this measure, dimension (a) is not reached on account of the safety hook movement being limited in front by the stop, this stop has to be filed down a little or else the safety hook has to be removed and recessed at the stop contact point. Furthermore, the hook bracket at the hood should be checked and, if necessary, bent into proper position.

## Front Bumper Removal and Installation

### Removal

- 1 - Remove the bumper bolts and nuts and take off bumper, reinforcement plates and overriders.

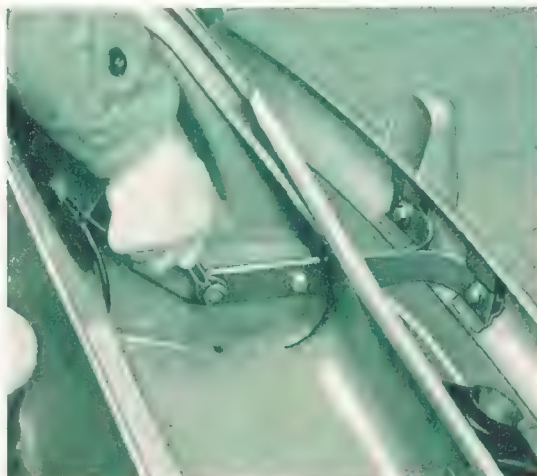


- 2 - Lift front hood and remove the spare wheel.
- 3 - Remove bumper bracket bolts on both sides and pull out the brackets from the front apron of the body.
- 4 - Take off bumper bracket grommets.

### Installation

The following points should be observed when installing the front bumper.

- 1 - Check condition of bumper bracket grommets and replace as necessary. Position grommets in the front apron.
- 2 - Insert the bumper brackets at the correct sides and bolt them into place.

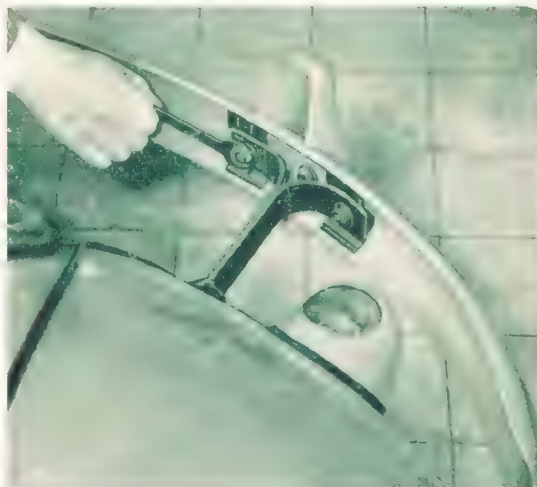


- 3 - Attach the bumper to the brackets. The overriders are attached to the outer bolts.

## Rear Bumper Removal and Installation

### Removal

- 1 - Remove bumper bolts and nuts and take off bumper and the four reinforcement plates.
- 2 - Remove overrider mounting bolts.
- 3 - Remove bumper bracket bolts on both sides and withdraw the brackets.
- 4 - Remove bumper bracket grommets.







### **Installation**

The following points should be observed when installing the rear bumper:

- 1 - Check condition of bumper bracket grommets and replace as necessary. Position grommets in rear fenders.
- 2 - Insert the bumper brackets at the correct sides and bolt them into place.
- 3 - Attach the overrides to the bumper and install the bumper.

## Bumpers

### (Karmann Ghia Models)

From Chassis No. 1 158 165, Body No. 3930, three-piece bumpers are being used on the Karmann Ghia Coupé in place of those made in one piece. The overriders have been modified at the same time. They are now open toward the body and have only one welded-in mounting plate instead of two.

The following parts are required for the installation of the new type bumpers and overriders:

#### Front:

1 Bumper center piece, front	Part No. 141 707 109
1 Bumper outer piece, front left	Part No. 141 707 113
1 Bumper outer piece, front right	Part No. 141 707 114
4 Bolts for bumper connection	Part No. 11 707 191 a
4 Nuts M 8	Part No. N 11 008 3
4 Lockwashers B 8	Part No. N 12 008 2
1 Overrider, front left	Part No. 141 707 155 A
2 Spacers	Part No. 141 707 121
2 Screws BM 8 × 75	Part No. N 10 375 1
4 Rubber beads	Part No. 141 707 241
2 Bumper brackets, front	Part No. 141 707 135 a

#### Rear:

1 Bumper center piece, rear	Part No. 141 707 309
1 Bumper outer piece, rear left	Part No. 141 707 313
1 Bumper outer piece, rear right	Part No. 141 707 314
4 Bolts for bumper connection	Part No. 11 707 191 a
4 Lockwashers B 8	Part No. N 12 008 2
4 Nuts M 8	Part No. N 11 008 3
1 Overrider, rear left	Part No. 141 707 335 A
1 Overrider, rear right	Part No. 141 707 336 A
2 Spacers	Part No. 141 707 121
2 Screws BM 8 × 75	Part No. N 10 375 1
4 Rubber beads	Part No. 141 707 241
1 Bumper bracket, rear left	Part No. 141 707 335
1 Bumper bracket, rear right	Part No. 141 707 336

Installing new type overriders on earlier front bumper:

- 1 - Remove bumper.
- 2 - Remove overriders.
- 3 - Replace old bumper brackets by the new ones (Part No. 141 707 135 a).
- 4 - Hold the new overrider in position and mark the fixing hole on the bumper. Drill the hole.
- 5 - Insert the 2 spacers (Part No. 141 707 121) when attaching the overriders.

Except for point 3, the aforementioned procedure also applies to the installation of new type overriders on earlier rear bumpers.

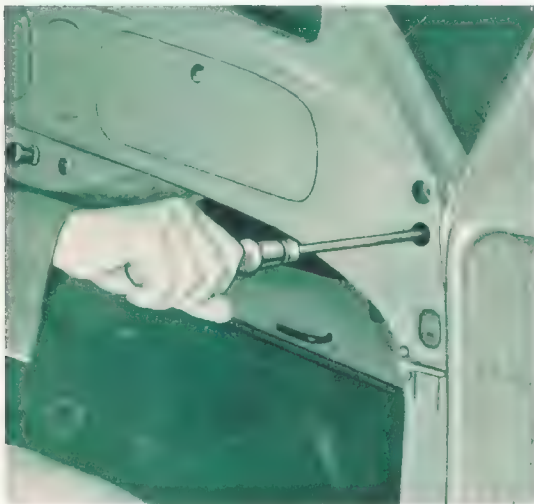
Installing earlier overriders on new type bumpers (front and rear):

- 1 - Screw the new bumper together, using the intermediate holes only.
- 2 - Hold the earlier overriders in position and file the upper and lower fixing holes to register with those in the overriders.
- 3 - Attach the overriders.

## Door Removal and Installation

### Removal

- 1 - Remove the two check rod retaining screws from the door hinge pillar.
- 2 - Remove the rubber plugs from the door hinge to gain access to the inner hinge screws.
- 3 - Remove the door hinge attaching screws from the pillar.

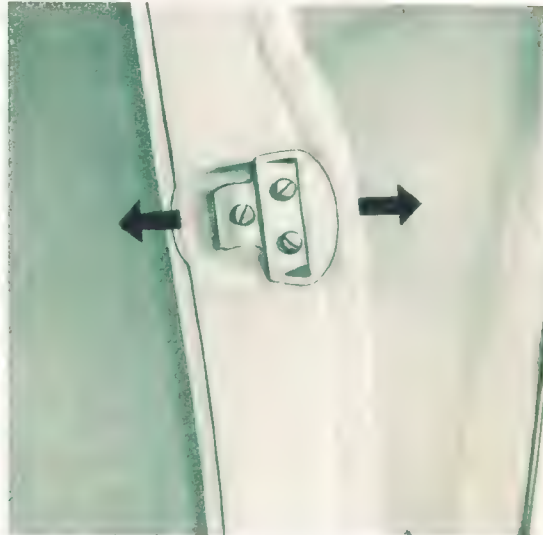


- 4 - Lift off the door.

### Installation

This is accomplished by reversing the removal procedure, but the following points should be observed.

- 1 - Check condition of door weather strips, replace as necessary. Cement the new weather strips into place, using VW Compound D 12.
- 2 - Attach the door to the pillar and make sure the door is properly aligned in the door opening. Do not adjust doors by springing or bending until it is determined that proper door fit cannot be obtained by adjustment at the rubber buffers and striker plate.



- 3 - Check door rubber buffers for wear, replace as necessary.



#### Note:

Adjustable rubber buffers are installed from:

	VW Sedan	VW Convertible
Chassis No.	1-441708	1-448117
Body No.	380257	12410

The door rubber buffers are subject to natural wear, necessitating an adjustment by loosening the Philips head screws and horizontally shifting the buffers to the required position. With the screw tightened, the serrations in the mounting parts avoid an accidental movement of the buffers. The adjustable buffers cannot be installed in earlier cars.



If an adjustment of the buffers no longer eliminates a door rattle, oversize buffers may be installed (obtainable from the factory).

- 4 - Lubricate the door hinges after dust and soil have been removed. Slightly grease the striker plate. The door lock cylinder should be treated with graphite, never with oil or grease. Blow a small quantity of powdered graphite through the key hole. Dip the key into the graphite, insert key and move it back and forth several times. Prevent oil or grease from getting into contact with the door rubber buffers. Should a squeaky noise occur, apply a light coating of talc powder to the rubber buffers. Also treat the door weather strips with talc powder to retain the original flexibility and to reduce friction.



## Door Check Rod Removal and Installation

### Removal

- 1 - Press down the escutcheon plates of window regulator handle and door handle, drive out the pins and take off the handles.



- 2 - To remove the trim panel, release the retaining clips by prying the panel away from the door. Care must be exercised not to damage the paint.



3 - Take off the escutcheon springs and rubber inserts.

4 - Remove the two check rod retaining screws from the door hinge pillar.



5 - Remove the cotter pin and take off check rod rubber cushion and washer.



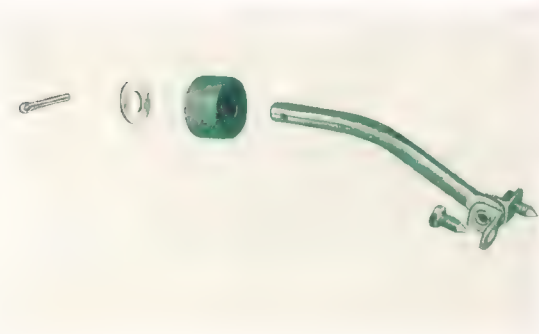
3 - When reinstalling the door trim panel, make sure that the oiled paper at the bottom is placed over the edge of the inner door panel to allow water to drain.

4 - Position the handles as shown below.

### Installation

To reinstall the unit, proceed in reverse order and observe the following points:

1 - Insert the check rod through the slot in the door and fit the parts in the correct order.



2 - Engage the arm rest bracket with the door inner panel center bar as shown by the arrow.

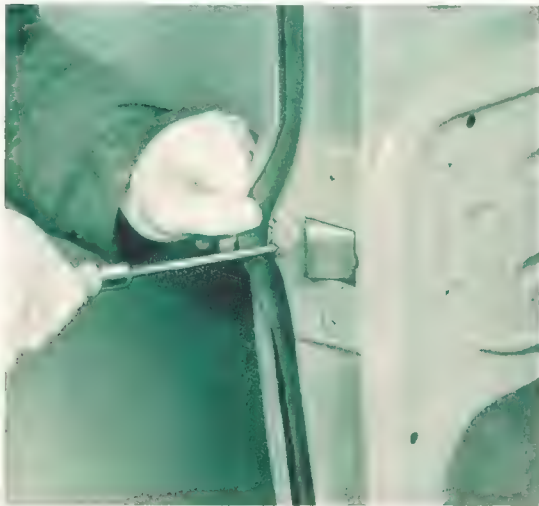


5 - Lightly oil the door check rod joint. A few drops of oil on the check rod will eliminate a squeaky noise at the leather washer.

## Door Lock Removal and Installation

### Removal

- 1 - Remove inner door handle and regulator handle.
- 2 - Remove door trim panel.
- 3 - Remove window regulator.
- 4 - Remove the two screws concealed behind the weather strip.



### Installation

To install the door lock, reverse the preceding operations. Observe the following points:

- 5 - Take off the outer door handle and rubber seal.
- 6 - Remove the four door lock attaching screws and the two screws holding the remote control bracket to the door panel.
- 7 - Remove the rear glass-run channel attaching screw.
- 8 - Lift up the glass and take off door lock and remote control assembly.
- 1 - Check all components, replace damaged parts.
- 2 - Clean the lock and grease all moving parts with Universal Grease VW - A 052.
- 3 - Make sure the rubber sleeve on the remote control rod is at the point where the rod is guided in the inner door panel. The guide plate should bear slightly preloaded on the remote control rod to avoid a rattling during operation.
- 4 - Blow powdered graphite into the lock cylinder.

## Glass Removal and Installation

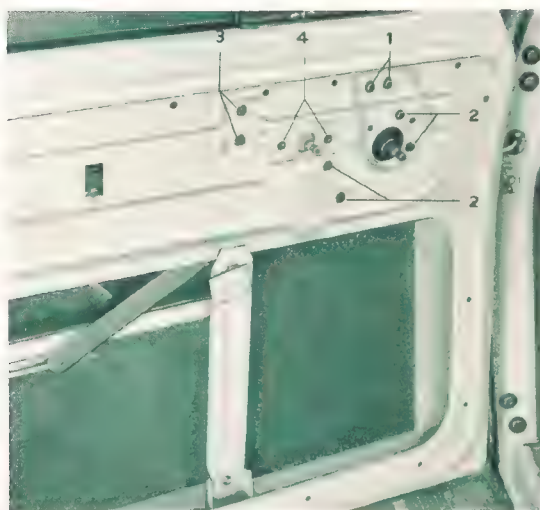
All glass panels are of safety glass and can be replaced. To assure a perfect seal, it is important to repair or straighten damaged or bent window frames before installing new glass panels. The seating faces for the weather strips and seals must be smooth and clean.

## Vent Wing Removal and Installation

### Removal

- 1 - Remove inside door handles.
- 2 - Take off the escutcheon springs and rubber inserts.
- 3 - Remove the two screws holding the vent wing check-stay in place.





- 1 - Vent wing check-stay screws
- 2 - Window regulator screws
- 3 - Front glass-run channel screws
- 4 - Door lock remote control screws

4 - Draw the check-stay and clutch sleeve down and out through opening in bottom of door panel.



- 1 - Vent wing
- 2 - Clutch sleeve
- 3 - Check-stay

5 - Remove the rivet at the vent wing upper retaining bracket.

6 - Turn up the vent wing handle and remove the vent wing.

7 - Remove the vent wing weather strips from the door window frame.

8 - Remove screws from vent wing upper retaining bracket and take off the bracket.



### Installation

1 - Install the vent wing retaining bracket.

2 - Check condition of weather strips and place them into position.

3 - Place the vent wing in the door window frame and rivet it to the upper retaining bracket, using an ordinary riveting tool, as shown on the next page.



- 4 - Slide the check-stay and clutch sleeve on the vent wing pivot pin and tighten the two attaching screws.

**Note:**

The spring-loaded check-stay can be adjusted to ensure that the vent wing can be opened and closed without excessive force.

- 5 - Install rubber inserts, escutcheon springs, trim panel, window regulator handle and inner door handle. Check all mechanisms for proper functioning by operating the handles.

## Door Vertical Sliding Glass Removal and Installation

### Removal

- 1 - Open the door and run window all the way down.
- 2 - Remove regulator handle and inner door handle.
- 3 - Remove door trim panel, escutcheon springs and rubber inserts.
- 4 - Remove the four window regulator attaching screws.
- 5 - Press the regulator towards the door outer panel and pull it out through opening in bottom of inner door panel, after having detached the roller arm from the retainer channel.



- 6 - Remove the screw that attaches the front glass-run channel to the inner panel center bar. Remove the screw at the bottom of the center bar and take off center bar.



- 7 - Remove the two screws that attach the front glass-run channel to the inner door panel.
- 8 - Slide the glass down and tilt it for removal as shown on the following picture.



#### Installation

- 1 - Insert the door window glass vertically, turn it 90 deg. and slide it up in the glass-run channels.
- 2 - Install the door inner panel center bar and insert and tighten all front glass-run channel attaching screws.
- 3 - Grease all moving joints of the regulator mechanism, using Universal Grease VW-A052.
- 4 - Lower the glass 2/3 of its travel and connect the roller arm to the glass retainer channel.
- 5 - Install the regulator and screw it into place.

## Removal and Installation of Glass-run Channel Retainers

#### Removal

- 1 - Remove door vertical sliding glass.
- 2 - Remove the rear glass-run channel and retainer attaching screws and take off glass-run channel and retainer.



- 3 - Remove the front glass-run channel retainer attaching screws and pull down the glass-run channel and retainer.
- 4 - Lift off the weather strip clips at the window compartment opening by means of a screwdriver and remove the weather strip and clips and, with the De Luxe Model, also the garnish moulding as an assembly.

#### Installation

- 1 - Check the condition of the weather strip for the window compartment opening. Replace should it be found necessary.
- 2 - Attach the front glass-run channel and retainer to the door.
- 3 - Clip the weather strip to the window compartment opening (with the De Luxe Model also the garnish moulding).
- 4 - Install the rear glass-run channel and retainer.



- 5 - Install the vertical sliding glass.



## Windshield Removal and Installation

### Removal

- 1 - Fold the windshield wiper arms forward.
- 2 - Remove windshield and windshield weather strip by pushing outward, beginning at one of the upper corners.

### De Luxe only

- 3 - Drive the upper and lower sleeves from the garnish moulding ends.



- 4 - Remove the garnish moulding halves from the weather strip.

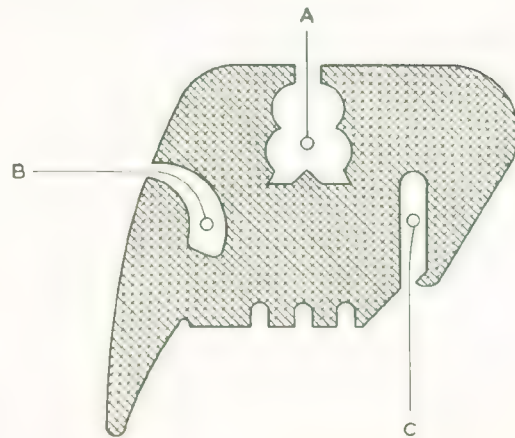
### Standard and De Luxe

- 5 - Remove the weather strip from the windshield.

### Installation

Installation is accomplished in reverse order, but the following points should be observed:

- 1 - Remove all traces of old sealing compound from the windshield frame, using benzine.
- 2 - Examine condition of weather strip.
- 3 - Place weather strip around windshield edge. The ends of the weather strips should meet in the center of the upper windshield side.



Section of windshield weather strip

- A - Windshield channel
- B - Garnish moulding channel
- C - Windshield frame channel

### Installing Garnish Moulding (De Luxe)

- 4 - Fit a strong cord around the channel for the garnish moulding.

This is done by means of a piece of tube, one end of which should be flattened. Insert the flat end into the channel and move it completely around the windshield as shown below. The cord, passing through the tube, is thus embedded in the channel as the tube is moved.



The cord should cross in the center of the upper or lower windshield side.

- 5 - First push one of the two moulding halves completely into place and then the other. Starting at the point where the cord ends cross, slowly pull out the cord while pushing the garnish moulding into place by hand until operation is complete.



- 6 - Install the two garnish moulding sleeves.

#### Windshield Installation

- 7 - Fit a strong cord around the outer channel of the strip. The cord ends should cross in the center of the bottom windshield side.
- 8 - Coat the outer circumference of the weather strip with VW Window Cement D 10.
- 9 - Coat the bottom corners of the windshield frame with VW Window Cement D 10.

- 10 - Position the glass against the windshield frame from outside the body. The cord ends must hang out inside the body.

- 11 - The installation of the glass requires two persons.

A helper inside the body pulls at one end of the cord parallel to the glass and around the frame to force the lip of the weather strip over the frame.

During this operation, the glass must be tapped into place from outside the body, following the pull of the cord.



- 12 - Remove excess sealing compound and clean the windshield glass. Test the windshield for leakage.

#### Note:

From August 1957 an enlarged windshield is installed. The front door pillars are narrower. The installation procedure remains the same as with the previous windshield.

## Removal and Installation of Side Window and Rear Window

These operations are nearly the same as those outlined under "Windshield Removal and Installation". The garnish mouldings are of one piece.

From Chassis No. 1-454 951 the rear window center bar has been omitted and the curved glass panel is of safety glass (formerly plain plate glass).

#### Note:

If multiple sheet is used in lieu of single sheet glass, the windows should be pushed into place. The use of a rubber hammer may damage the glass.

#### Note:

From August 1957 an enlarged rear view window is installed. The installation procedure remains the same as with the previous rear view window.

## Rear Side Window and Regulator Assembly on Convertible

### Removal

- 1 - Raise the top.
- 2 - Remove rear seat and back.
- 3 - Take off the rubber plug above the striker plate and remove the two window anchor bracket screws.



- 4 - Lower the window by two or three handle turns.
- 5 - Remove regulator handle and trim panel.



- 6 - Remove the four window regulator attaching screws. Press the regulator towards the outer

panel and pull it out through opening in bottom of inner panel, after having detached the roller arm from the glass retainer channel.

- 7 - Lift out the window glass.
- 8 - Remove the window compartment weather strip and the rubber piece on either end after having released the three attaching screws.
- 9 - Remove the three window guide attaching screws (two in window compartment, one at inner panel) and take out the window guide.



### Installation

Installation is a reversal of the above procedure, but the following points should be heeded.

- 1 - Check weather strips and replace when damage is apparent.
- 2 - Clean and grease window regulator.
- 3 - Raise and lower the window to insure that the window travels freely in the channel and that the weather strips seal perfectly.
- 4 - Coat the weather strips with talc powder.



### Rear Side Window Disassembly

- 1 - Take off the weather strip from the vertical side of the window.
- 2 - Remove the anchor bracket retaining screws and take off the bracket. Remove the window lift channel and pull out the glass.



- 3 - Take off the glass weather strips.

### Rear Side Window Assembly

Reverse the removal procedure and observe the following points. Check condition of weather strips and replace as considered necessary.

#### Note:

A - If the window cannot be raised sufficiently so that there is a gap at the door window, proceed as follows:

- 1 - Remove regulator handle and rear side trim panel.
- 2 - Lower the rear side window half its travel.
- 3 - The stop at the roller arm should be shortened (by means of a file) until the window frame is fully aligned to the door window frame. Reinstall trim panel and regulator handle.

B - If the vertical side of the window can be moved too far toward the front when raising the window, proceed as follows:

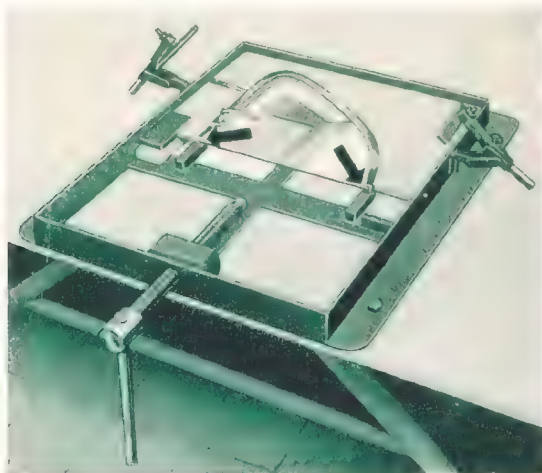
- 1 - Remove regulator handle and rear quarter trim panel.
- 2 - Lower the rear side window half its travel.
- 3 - Screw a nut (metric 6) on the rear upper regulator attaching screw. If the window then cannot be raised sufficiently, proceed as detailed under A.
- 4 - Reinstall trim panel and regulator handle.

## Removal and Installation of Vent Wing Glass

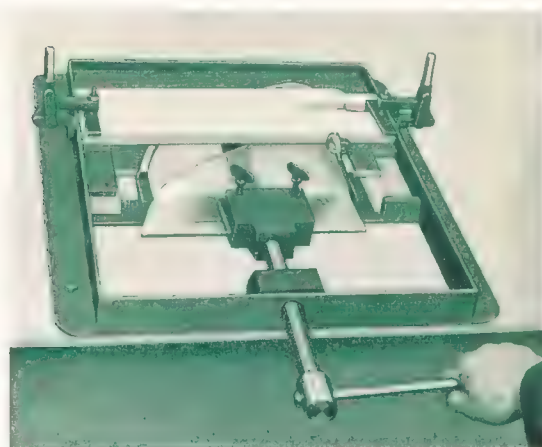
(Vent Wing Removed)

### Removal

- 1 - Place vent wing in appliance VW 737 so that the glass frame ends come to rest against the shoulders of the supports (see arrows).



- 2 - Place glass clamp on the spindle and turn the spindle toward the glass as far as it will go.
- 3 - Place rubber packings between glass and clamp, one on each side. Insert the pressure plate so that the wing screw ends come to rest in the two sinkings.
- 4 - Fully tighten the two wing screws by hand.
- 5 - Place the wooden thrust plate on the vent wing and tighten it in position by means of the two clamps.
- 6 - Withdraw the vent wing glass by turning the spindle anticlockwise.



- 7 - Loosen the wing screws and remove the glass.

- 8 - Release the clamps, take off thrust plate and vent wing frame.

### Installation

- 1 - Remove all traces of old cement at the vent wing handle.
- 2 - Coat the frame channel at the handle (see left-hand arrow) with VW Cement D 10.
- 3 - Coat both sides of the weather strip with powdered talc.
- 4 - Clamp vent wing pivot pin in a vise and place the weather strip in the frame channel as shown below.



**Note**

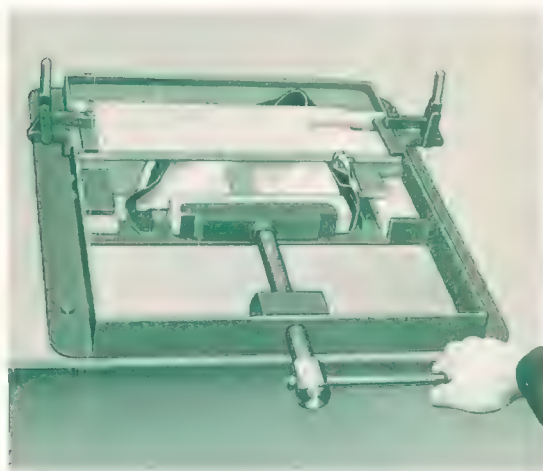
Special care should be taken that the weather strip is not pushed in the channel at the point indicated by the right-hand arrow to avoid the forming of folds when pressing in the glass. It should be made sure that the two triangular plates at the vent wing handle are fully covered by the weather strip.

- 5 - Slide in the glass as far as it will go by hand pressure. When doing this, support the frame with one hand.



- 6 - Place vent wing appliance VW 737.

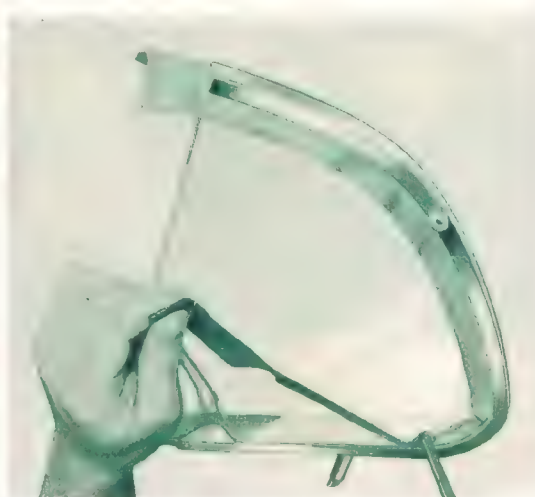
- 7 - Place the wooden thrust plate on the vent wing and tighten it in position by means of the two clamps.



- 8 - Place the wooden thrust channel against the glass and press in the glass by turning the spindle clockwise.

- 9 - Back off the spindle and remove thrust channel. Release the clamps and take off thrust plate and vent wing.

- 10 - Cut off the surplus rubber. Care should be taken that the cut edge is below 90 degrees to allow the water to drain off.



- 11 - Check for proper seal by spraying water against the vent wing.

**Note**

The two adaptors are to be turned by 180 degrees when removing and installing the glass of the opposite vent wing.



# Windshield Glass Removal and Installation

(Laminated safety glass)

## Removal

- 1 - Fold the windshield wiper arms forward.
- 2 - Use a wedge-shaped fiber or hardwood tool to loosen weather strip from body, at the same time spraying glycerin between weather strip and body edge. Carefully push out the windshield together with weather strip, starting at one of the upper corners.

## De Luxe only

- 3 - Drive the upper and lower sleeves from the garnish moulding ends.
- 4 - Remove the garnish moulding halves from the weather strip.
- 5 - Work the weather strip off the glass.

## Installation

Installation is accomplished in reverse order, but the following points should be observed:

- 1 - Remove all traces of old sealing compound from the body edge, using a solvent.
- 2 - Examine condition of weather strip, replace if found necessary.
- 3 - Work weather strip over the glass. The ends of the weather strip should meet half way between the upper corners.

### Note:

Laminated safety glass is marked Sigla, Kinon, or Delog. The glass should be installed so that the designations can be read from outside the car.

## Installing Garnish Moulding (De Luxe)

- 4 - Fit a cord around the channel for the garnish moulding.

This is done by means of a piece of tube, one end of which should be flattened. Insert the flat end into the channel and move it completely around the windshield. The cord, passing through the tube, is thus embedded in the channel as the tube is moved. The cord should cross in the center of the upper or lower windshield side.

- 5 - First push one of the two moulding halves completely into place and then the other. Starting at the point where the cord ends cross, slowly pull out the cord while pushing the garnish moulding into place by hand until operation is complete.

- 6 - Install the two garnish moulding sleeves.

## Installing Windshield Glass

- 7 - Insert a cord (about 2—3 mm dia./ .08—.12") into the outer groove around the weather strip. The cord ends should hang out in the middle of the lower side.

- 8 - Coat the outer circumference of the weather strip with VW Window Cement D 10.

- 9 - Coat the lower corners of the body edge with VW Window Cement D 10.

- 10 - Coat weather strip lip and body edge with glycerin.

- 11 - First position the lower edge of the glass against the body opening from outside and exert equal pressure with both hands against the glass to seat it in the body opening. Care should be taken to avoid one-sided pressure.

A helper inside the body pulls at one end of the cord parallel to the glass and around the edge to work the lip of the weather strip over the edge of body opening.

- 12 - Wipe off surplus cement with alcohol. Check windshield for tightness.

## Door Removal and Installation

### Removal

- 1 - Disconnect the check rod from the door hinge pillar by removing the pin.
- 2 - Remove the rubber plugs from the door hinges to gain access to the inner hinge screws.
- 3 - Remove the door hinge screws from the pillar.



### Note:

The plastic wedge is wear-resistant and requires no maintenance attention. The plastic wedge spring is replaceable. A new spring should be amply provided with grease before installation.

- 4 - Lift off the door.

### Installation

This is accomplished by reversing the removal procedure, but the following points should be observed.

- 1 - Check condition of door weather strips, replace as necessary. Cement the new weather strips into place, using VW Compound D 12.
- 2 - Attach the door to the pillar and make sure the door is properly aligned in the body opening. Do not adjust doors by springing or bending until it is determined that proper door fit cannot be obtained by adjustment at the striker plate.
- 3 - Adjust striker plate to align door rear edge with rear quarter panel and to assure an easy closing of the door.



- 4 - Lubricate the door hinges after dust and soil are removed. Spread a thin film of grease over the striker plate. The door lock cylinder should

be treated with graphite, never with oil or grease. Blow a small quantity of powdered graphite through the key hole. Dip the key into the graphite, insert key and move it back and forth several times.



## Door Check Rod Removal and Installation

### Removal

- 1 - Press down the escutcheon plates of window regulator handle and door handle, drive out the pins and take off the handles, and escutcheon plates.



- 2 - Remove the trim panel by prying it away from the door, unsnapping the concealed fasteners.

Care must be exercised not to damage the paint.



- 3 - Take off the escutcheon springs and rubber inserts.
- 4 - Remove the check rod pin retaining ring and take off the pin.



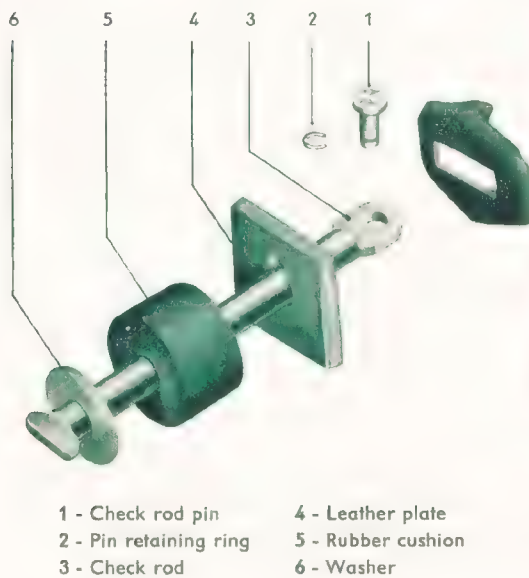


- 5 - Turn check rod 90° and withdraw rod and rubber cushion from the door shell through the slot in the leather guide plate.

#### Installation

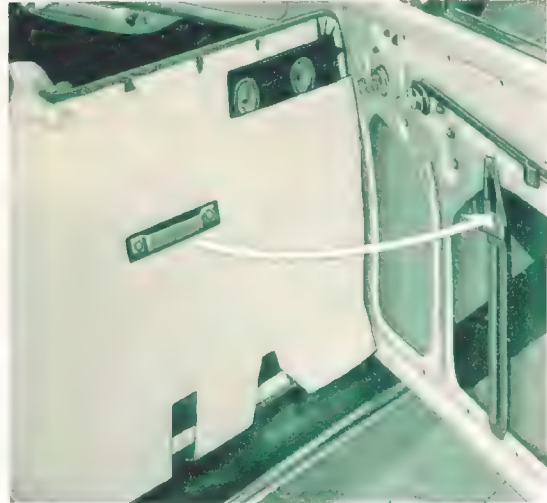
To reinstall the unit, proceed in reverse order and observe the following points:

- 1 - Insert the leather plate from inside the door, slide washer and rubber cushion to check rod end, and push the rod through the leather plate slot.



- 2 - When reinstalling the door trim panel, make sure that the oiled paper extends over the bottom edge of the inner door panel to allow water to drain.

- 3 - On the nearside door, engage the arm rest bracket with the door inner panel center bar.



- 4 - Install rubber inserts, escutcheon springs, and door trim panel.

- 5 - Position the handles as shown below (door handle 16° toward the rear when in the unlocked position). Check for proper functioning by operating the handles.



- 6 - Lightly oil the door check rod pivot point. A few drops of oil on the check rod will eliminate a squeaky noise caused by friction in the leather plate.

## Door Lock Removal and Installation

### Removal

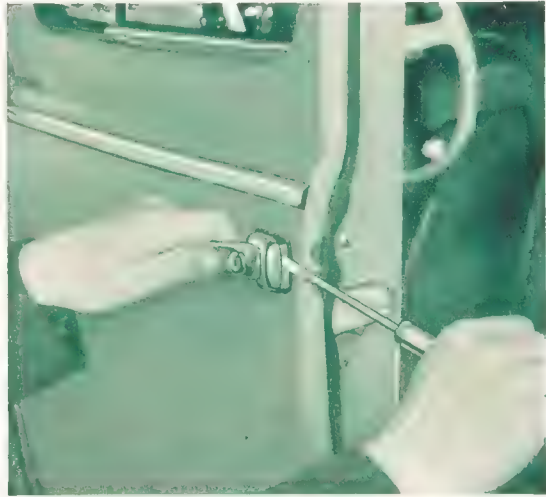
- 1 - Remove inner door handle and window regulator handle.
- 2 - Remove door trim panel.
- 3 - Remove window regulator and lift out sliding glass.
- 4 - Disconnect remote control rod from lock by removing C-washer, and take off the spring washer.



- 5 - Remove the two screws holding the remote control bracket to the door panel and take off remote control assembly.
- 6 - Remove the two outer door handle attaching screws.



- 7 - Pry off the outer door handle and rubber seal.



- 8 - Remove the three door lock attaching screws.



- 9 - Remove the lowest rear glass-run channel attaching screw.

- 10 - Take off door lock.



### Installation

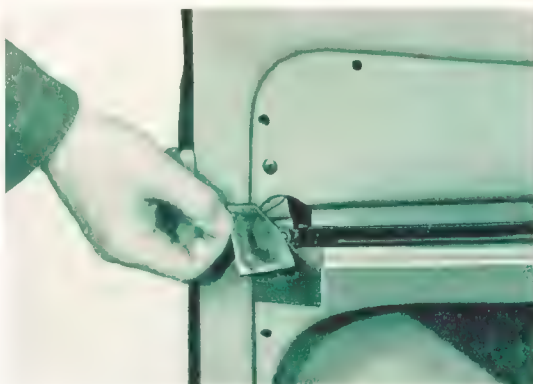
To install the door lock, reverse the preceding operations and observe the following points.

- 1 - Check all components, replace as necessary.
- 2 - Clean the lock and remote control and grease all moving parts with Universal Grease VW — A 052.

3 - Place remote control rod in rubber-covered support.

4 - Install spring washer prior to connecting remote control rod to door lock.

5 - Do not forget to cement leather protection cover over the door lock opening.

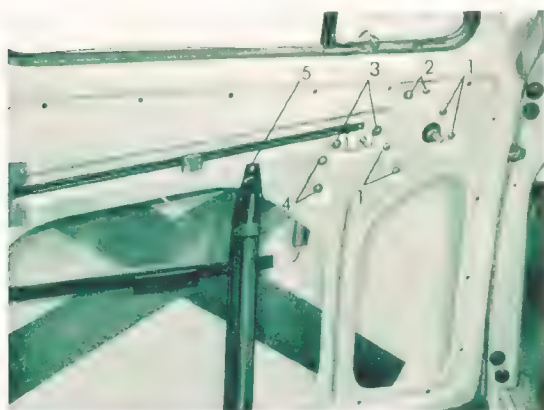


6 - Blow powdered graphite into the lock cylinder.

## Door Vertical Sliding Glass Removal and Installation

### Removal

- 1 - Run window down two-thirds of its travel.
- 2 - Remove regulator handle and inner door handle.
- 3 - Remove door trim panel, escutcheon springs and rubber inserts.



- 1 - Regulator screws
- 2 - Vent wing check-stay screws
- 3 - Door lock remote control screws
- 4 - Front glass-run channel screws
- 5 - Center bar screw

4 - Take off center bar after removal of screw with Phillips screwdriver.

5 - Release the four regulator attaching screws.

6 - Press the regulator towards the door outer panel and pull it out through opening in bottom of inner door panel, after having detached the roller arm from the glass retainer channel.





7 - Remove the two front glass-run channel screws.

8 - Remove the lower rear glass-run channel screw with a Phillips screwdriver.



9 - Slide the glass down and tilt it for removal as shown in the following picture.



#### Installation

1 - Insert the door window glass vertically, turn it 90 deg. and slide it up in the glass-run channels.

2 - Grease all moving parts of the regulator mechanism, using Universal Grease VW — A 052.

3 - Lower the glass two-thirds of its travel and connect the roller arm to the glass retainer channel.

4 - Install the regulator and screw it into place.

5 - Insert and tighten all glass-run channel attaching screws and install the center bar.

## Vent Wing Removal and Installation

### Removal

1 - Remove inner door handle and window regulator handle.

2 - Take off door trim panel, escutcheon springs, and rubber inserts.

3 - Remove the two screws holding the vent wing check-stay in place.

4 - Remove the rivet at the vent wing upper pivot point.



- 5 - Partially open the vent wing and lift it out.
- 6 - Take off vent wing check-stay from inside the door.



- 1 - Vent wing
- 2 - Check-stay base
- 3 - Check-stay cover
- 4 - Attaching screws

- 7 - Remove the vent wing weather strip from the door window frame.
- 8 - Remove vent wing upper pivot bracket and vent wing lock plate.



#### Installation

- 1 - Install upper pivot bracket and vent wing lock plate.
- 2 - Check condition of weather strip and place it into position.

- 3 - Hook check-stay cover to check-stay base and hold the assembly against the inner door panel from inside the door shell — the joint of the check-stay must be toward the door hinges —, tighten the check-stay screws a few turns.

- 4 - Place the vent wing in the door window frame, taking care that the shaft passes through the check-stay.

- 5 - Rivet the vent wing to the upper pivot bracket.



- 6 - The amount of frictional resistance can be adjusted by tightening or loosening the rear screw.



- 7 - Install rubber inserts, escutcheon springs, trim panel, window regulator handle, and inner door handle. Check all mechanisms for proper functioning by operating the handles.

## Door Vertical Sliding Glass Removal and Installation

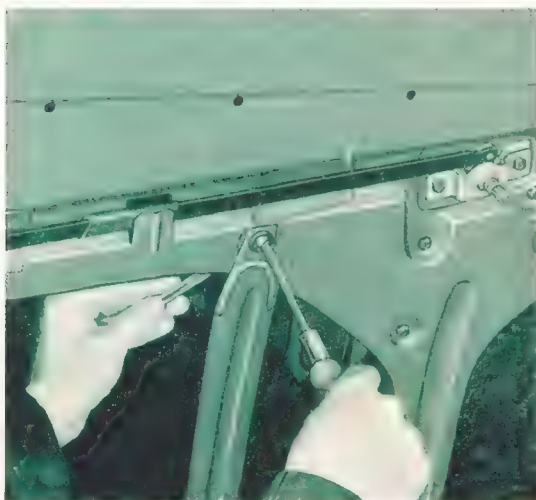
### Removal

- 1 - Run window down  $\frac{3}{4}$  of its travel.
- 2 - Remove regulator handle and inside door handle.
- 3 - Remove the door trim panel, escutcheon springs, and rubber inserts.

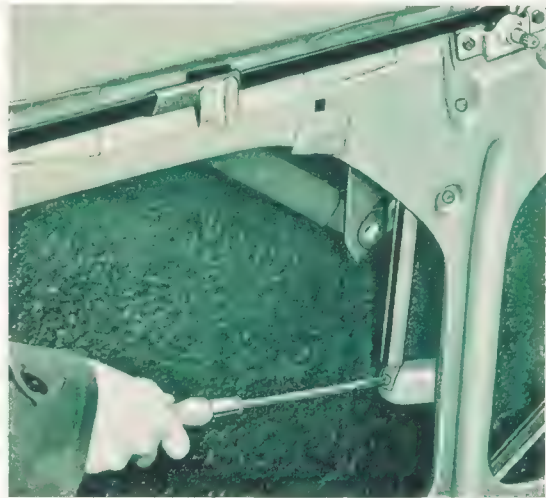


- 1 - Regulator screws
- 2 - Door lock remote control screws
- 3 - Vent wing check-stay screws
- 4 - Center bar screw

4 - Take off center bar after removal of screw.



- 5 - Remove the screw at the bottom of the front glass-run channel.



- 6 - Remove the six window regulator attaching screws.

- 7 - Push the regulator towards the door outer panel and pull it out through opening in bottom of inner door panel, after having detached the roller arm from the glass retainer channel.





- 8 - Remove screw at the top of the rear glass-run channel and lift out the glass.



- 6 - A vertical adjustment of the door windows is effected by a stop (1) which bears against an adjusting screw (2) located behind the door inner panel. The lock nut (3) of the adjusting screw is to be loosened before a correction is made.

The adjustment is correct when the window is flush with the upper edge of the vent wing.

#### Installation

- 1 - Take care not to damage the weather strip when inserting the glass into its channels.
- 2 - Prior to installation, grease all moving parts of the regulator mechanism, using Universal Grease VW — A 052.
- 3 - Install the regulator and screw it into place.
- 4 - Check sliding glass for free movement. If the glass binds, loosen the bottom screws of the channels and move the channels sidewise. Retighten the screws.
- 5 - Care should be taken that the door window glass is in line with the rear quarter glass so that there is a perfect seal at the door window frame weather strip.

The position can be corrected after the screw at the top of the door rear glass-run channel has been loosened.



- 7 - Tighten glass-run channel screws and install the center bar.

An accurate adjustment of the striker plate for the new door lock on VW Passenger Cars delivered since August 1955 calls for the study of some special instructions. A proper door fit is the first requirement to be met.

## Door Fit



The door is properly aligned in the door opening, if:

- 1 - the amount of gap at the roof and at the door lock pillar is nearly equal,
- 2 - the door is flush with the side panel,
- 3 - the belt lines of door and side panel properly align,
- 4 - the door neither binds at the top nor at the bottom,



- 5 - the door weatherstrip evenly bears against the body at sufficient tension.

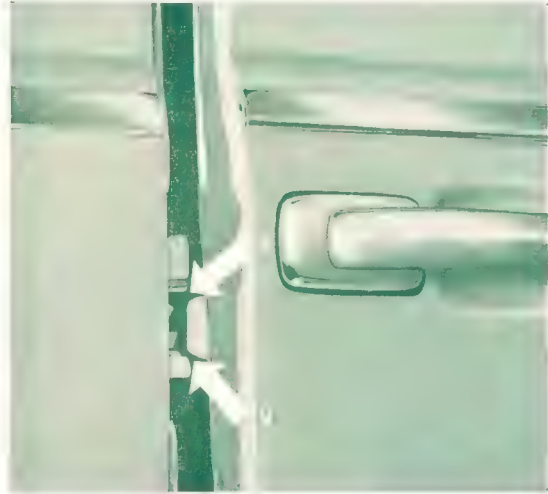
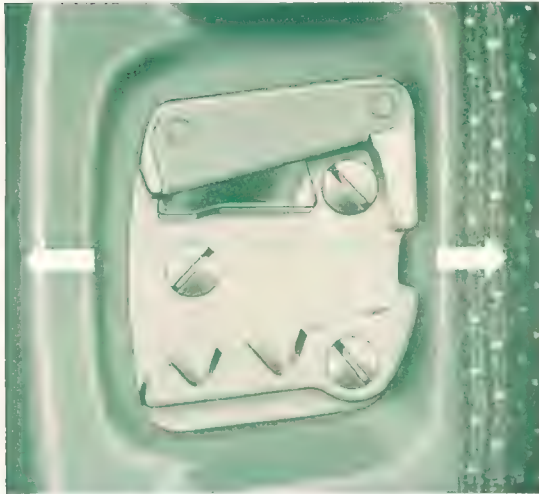


The door must open and close without bind. The best possible door fit should be approached by considering the points 1, 2, 3 and 5. If the conditions given under 1 and 3 cannot be coordinated, the equal space is preferable to the alignment of the belt line. Springing or bending the doors necessitates a check of the striker plates.

## Adjustment of Door Lock Striker Plate

- 1 - Adjust striker plate "in" or "out" to obtain a flush fit of the door rear edge to the body. If, in exceptional cases, the tightness of the door

The "up" and "down" adjustment of the striker plate can be checked when pulling back the weatherstrip lip with the door nearly closed.

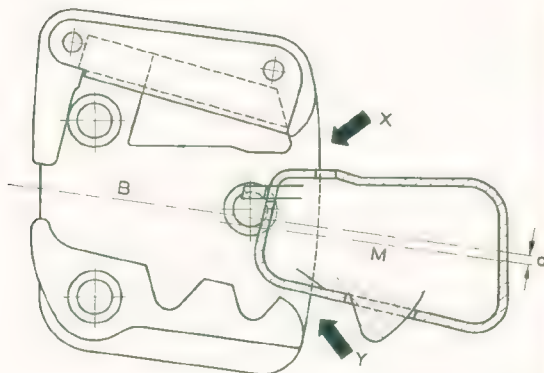


against the body is then insufficient, suitable strips of pasteboard may be cemented to the door frame (top and rear edges of the door) behind the weatherstrip.

- 2 - "Up" and "down" adjustment of the striker plate should be done as indicated in the drawing.

The space "x" should be slightly larger than space "y".

- 3 - If correctly adjusted, the door latch should bear on the points marked 1, 2 and 3. The width of the contact (a) should be about 8 mm (.31") and should never be less than 5 mm (.2").



B = Line of movement  
M = Center line  
a = 1.5 mm (.06")



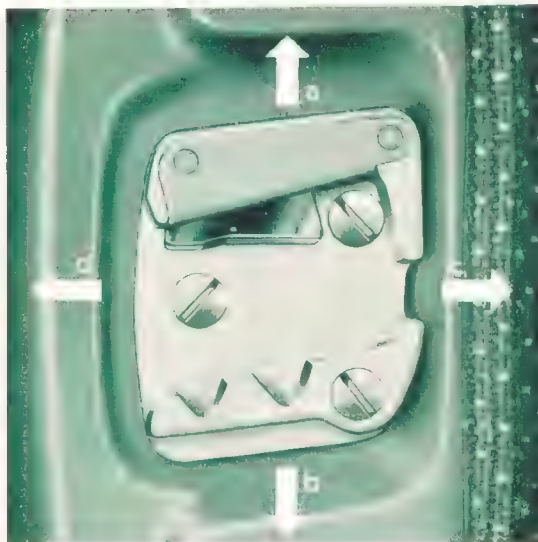




4 - Check impression of door latch contact and correct where necessary.

a - Door latch hitting the narrow face of the plastic wedge when closing the door:  
Plastic wedge excessively worn.  
Striker plate positioned too low.

b - Too tight a contact between door latch bottom and grooved face of striker plate:  
Striker plate positioned too high.



c - Door latch contacting the edge **above** the end radius of the striker plate grooved face:

Move the striker plate inward; if necessary, turn it somewhat clockwise.

The edge above the end radius only serves as a stop when slamming the door.

d - Door latch does not bear **in** the end radius of the striker plate:

Move the striker plate outward; if necessary, turn it somewhat anticlockwise.

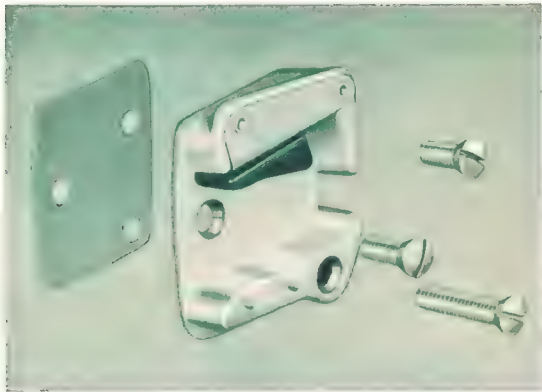
In isolated cases it may become necessary to improve the impression of the door latch contact by removing metal from the striker plate with a triangular scraper.

e - Door latch does not bear, or insufficiently bears, on the face in front of the end radius.  
Turn striker plate as found necessary to improve the contact.

f - Door latch does not bear, or insufficiently bears, on the face between the two grooves.  
Turn striker plate as found necessary to improve the contact.



5 - If the width of the contact is less than 5 mm (.2"), fit a plastic shim (Part No. 111 837 293) between striker plate and pillar. Too narrow a contact causes burr and wear on the door latch which will develop noises.



6 - Securely tighten the street countersunk screws (0.6—0.7 mkg / 4—5 ft. lbs.).



## Inspection of Door Latch and Striker Plate

Whenever adjusting the striker plate, it should be inspected in connection with the door latch as detailed below:

1 - The top and bottom surfaces of the latch must be smooth. The edges of the hole above the locking plate and those of the hole for the

striker must not stick up from the door latch surface.

2 - Check the door lock mechanism for proper operation. The striker must fully retract when pulling the handle to assure an easy opening of the door.



- 3 - The door latch contact face must be free from burr at the edges. Smooth down if necessary.
- 4 - Striker plates showing excessive wear at the lock housing contact faces or at the latch contact faces must be replaced.
- 5 - If the wedge after opening of the door remains in its end position check whether the head of the upper mounting screw for the striker plate prevents the wedge from moving forward. If this is not the case replace the striker plate.
- 6 - The pre-loaded wedge is supposed to exert a certain amount of pressure on the lock. Therefore check the tension of the spring. With the wedge in its extreme rear position the tension should be:

$2.8 \pm 0.5 \text{ kg (} 6.2 \pm 1.1 \text{ lbs.)}$



## Door Lock Striker Plate with adjustable Wedge

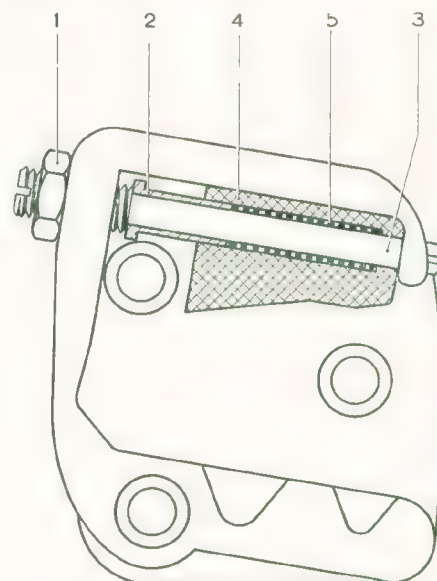
From Chassis No. 1 371 328 modified striker plates are installed in current production. With these new striker plates displacement of the wedge owing to impacts of the vehicle has been counteracted by means of an adjustable contact face. A screw with contact bush is adjusted in such way that the wedge is practically stationary with the door closed.

The following points should be observed during installation:

- 1 - Install striker plate of new design. Adjustment as to height and to side is carried out as previously. The striker plate must be a tight fit in the door pillar.
- 2 - Tighten securing screws for striker plates.
- 3 - Loosen lock nut (1) at the adjusting screw (3). Hold adjusting screw with the screw driver.
- 4 - Move the contact bush (2) toward the wedge (4) by turning the adjusting screw to the left until an increased resistance can be felt when opening the closed door.

If the resistance on opening the door is too great or the door jumps open on its own the

adjusting screw must be turned in until the door closes properly.



- |                  |                     |
|------------------|---------------------|
| 1 - Lock nut     | 3 - Adjusting screw |
| 2 - Contact bush | 4 - Wedge           |
|                  | 5 - Spring          |

- 5 - Hold adjusting screw with the screw driver and tighten lock nut.



6 - With a new striker plate a contact face will first tend to give a bit. Therefore, a second adjustment becomes necessary after some time. Proceed as pointed out in figures 3, 4 and 5.

7 - The latch contact faces at the striker plate and those for the wedge should only be slightly coated with Vaseline or with paste for this purpose.

## Door Locks for RHD Vehicles

From Chassis No. 1 222 269 RHD Sedans and Convertibles are provided with a door lock on the driver's side as standard equipment. If it is intended to install this kind of lock the two locks in the car must be exchanged for two new ones.

The following points should be observed:

1 - Remove both door locks inclusive of pull rods, remote control locks and exterior door handles.

2 - Remove rivets for pull rods at the remote control locks and take off pull rods.

3 - Rivet new remote control locks to the old pull rods. Install the old spring washer between the pull rod and remote control lock.

4 - Install new locks with remote control locks and pull rods.

5 - Interchange both outer door handles, so that the lockable door handle is on the right.

## Keys and Locks

Since January 1954 the door locks and the ignition/starting switch can be operated with one key. If a lockable handle is subsequently installed on the rear hood the lock can be adapted to the tumbler combination used on the door lock and ignition/starting switch.

Whenever exchanging a lock cylinder for a new one it is possible to restore the uniform tumbler combination.

As a keeping in stock of the entire range of locks would be too complex our Parts Department will supply disassembled lock cylinders as SP sets.

When replacing a door handle or a lock cylinder, the tumblers can be arranged in the desired combi-

nation in accordance with the code list, which our Spare Parts Department will supply. If replacement of the ignition/starting switch becomes necessary the tumbler combination of the door and rear hood locks, if provided, should be adapted to that of the new ignition/starting switch. It is not possible to remove the lock cylinder of ignition/starting switches.

Our Parts Department no longer supplies locks with pre-set tumbler combinations. In future the desired assembly of lock cylinders is to be carried out by VW Distributors or General Importers.

Orders for code lists and the corresponding SP sets should be placed with the Parts Department.

## Door Lock and Remote Control

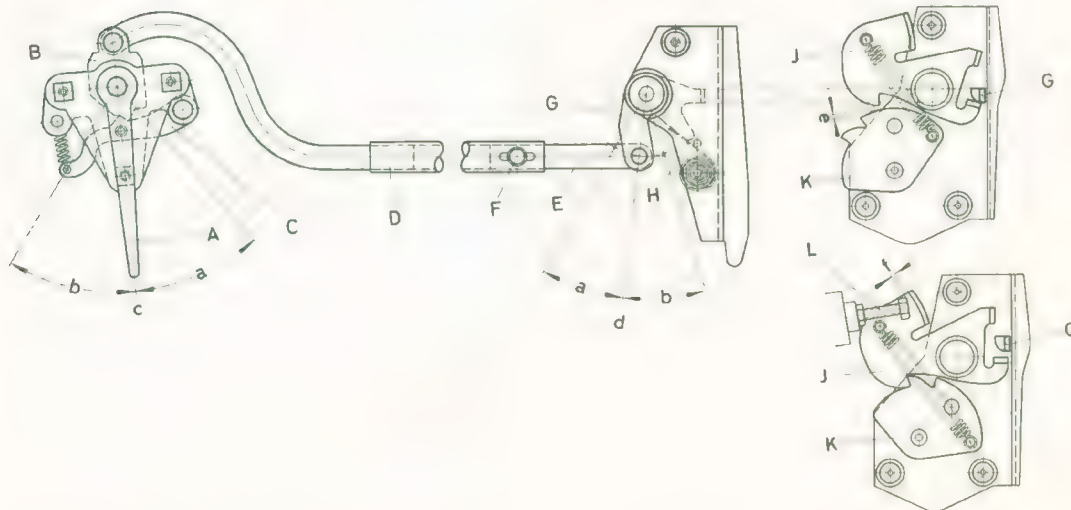
Difficulties experienced in opening and closing the door can be eliminated by a careful adjustment of the remote control rod and of the outer door handle.

Adjustment should be effected as follows:

- 1 - Loosen the locking screw (F) for the remote control rod (D).
- 2 - Set the inside handle (A) into neutral position (c). This position is obtained by bringing the mating surfaces of levers (B) and (C) into contact.
- 3 - Connect the remote control rod (D) to the link (E) by means of the lock screw (F) so that the release lever (G) is brought into contact with the spring (H) and, with the inner door

handle (A) in opening position (a), there is a play (e) of 2 mm between the stop (J) and the counterstop (K).

- 4 - A distance (f) of 1 mm is required between the head of the outer door handle adjusting screw (L) and the carrier of stop (J). If the play is too large, the stop (J) will not disengage properly and opening the door from the outside will become quite difficult. If the play is not large enough, the stop (J) will not engage the counterstop sufficiently to ensure proper operation.
- 5 - After adjustment, check door lock and remote control for proper functioning and oil all pivot points.

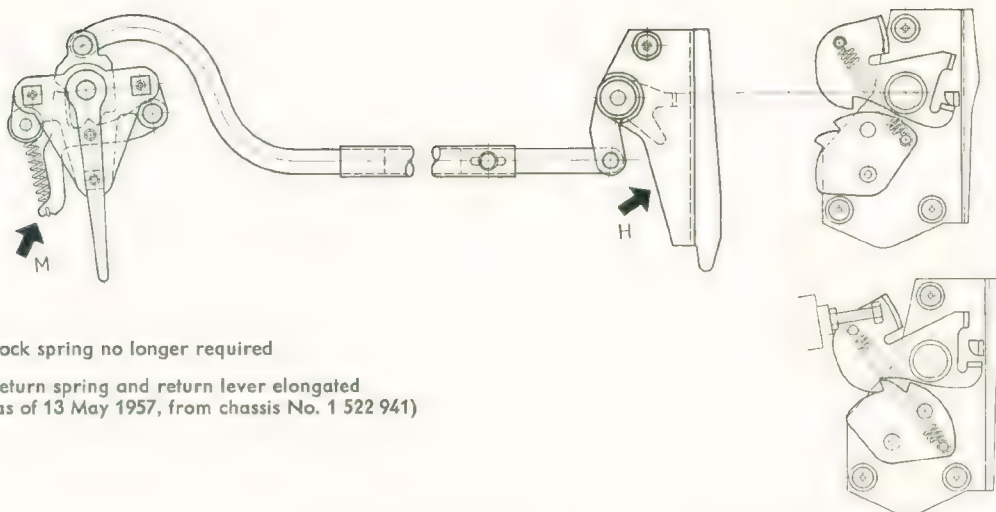


- A - Inner door handle
- B - Handle lever
- C - Remote control lever
- D - Remote control rod
- E - Connecting link
- F - Lock screw

- a - To open the door
- b - To lock the door
- c - Neutral position of handle

- G - Release lever
- H - Lock spring
- J - Stop
- K - Counterstop
- L - Adjusting screw with lock nut at the cylinder lock

- d - Neutral position of release lever
- e - 2 mm
- f - 1 mm



H - Lock spring no longer required

M - Return spring and return lever elongated  
(as of 13 May 1957, from chassis No. 1 522 941)

## Door Lock mounting

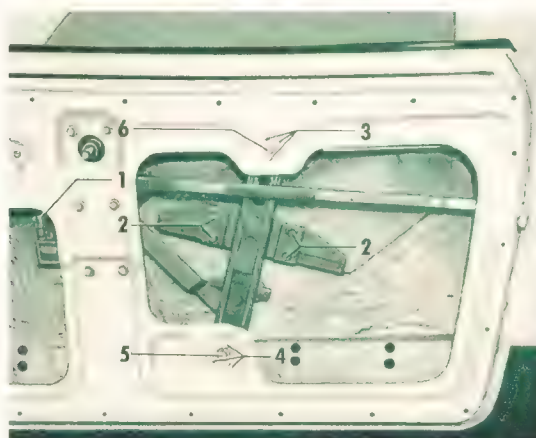
1 - If the door lock is found to be loose, the three Philips head screws AM 5×12 (Part No. N 14 265 1) should be replaced by slotted screws AM 5×15 DIN 91 (Part No. N 11 960 1) and toothed washers V 5.3 DIN 6798 (Part No. N 12 113 1). Carefully tighten the lock attaching screws.

2 - If the door fit needs adjustment, release the three Philips head screws M 8 in the striker plate and adjust the plate. Carefully tighten the screws after adjustment.



## Door Window Adjustment

The door window glass can be adjusted vertically, longitudinally and in or out. Access to the window regulator is obtained by removing the regulator and inside door handles, the trim panel, and the glued-in cloth lining.





### 1 - Vertical adjustment

Loosen adjusting screw lock nut (1). Vertical adjustment is made by turning the adjusting screw.

Anti-clockwise = glass is lowered  
Clockwise = glass is raised

Be sure to retighten the lock nut afterwards.

### 2 - Longitudinal adjustment

Loosen the four screws M6 (2) and shift the glass

backward or forward. Be sure to fully tighten the four screws afterwards.

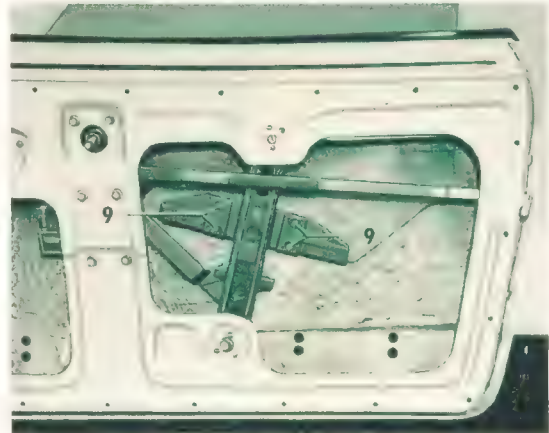
### 3 - "In" and "out" adjustment

Loosen hex. screw M8 (5) and countersunk screw M8 (6) that attach the window glass guide. Correct the position by screwing the three grub screws at the upper end of the guide (3) and at the lower end (4) in or out as required. The three-point adjustment at either end of the guide allows the window glass to be brought into perfect alignment with the body. Be sure to retighten the two attaching screws.

## Free Sliding Action of Door Window Glass

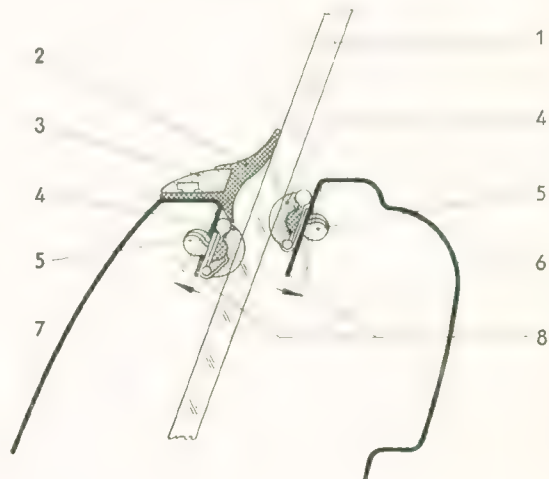
Should the door window glass be found to bind or to foul the clips of the two brush-type sealing strips in the door aperture, the following steps should be taken to effect a remedy:

- a - Remove the door lock remote control handle, window regulator handle, and trim panel.
- b - Pull off the cloth lining cemented to the door inner panel.
- c - Remove the four screws (9) and lower the glass as far as possible.
- d - Withdraw brush-type sealing strips (4) and compress the clips (5). Replace sealing strips, if unduly damaged.
- e - Enlarge the door aperture by prying apart the flanges (8) of the inner and outer panels as indicated by the dotted lines.
- f - Install brush-type sealing strips.

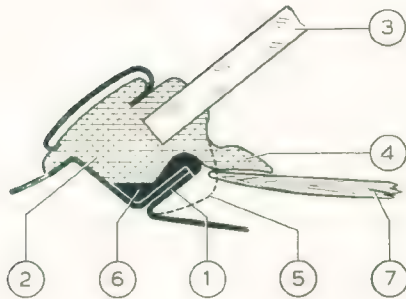


- g - Install the door window glass and, if found necessary, adjust its position as detailed in Workshop Bulletin A/51.

- 1 - Door window glass
- 2 - Rubber sealing strip
- 3 - Moulding
- 4 - Brush-type sealing strips
- 5 - Clips
- 6 - Door inner panel
- 7 - Door outer panel
- 8 - Door panel flanges



## Leaks at Windshield and Rear Window



- 1 - Body flange
- 2 - Weatherstrip
- 3 - Glass
- 4 - Lip raised by wooden wedge
- 5 - Normal position of lip
- 6 - Cement
- 7 - Wooden wedge

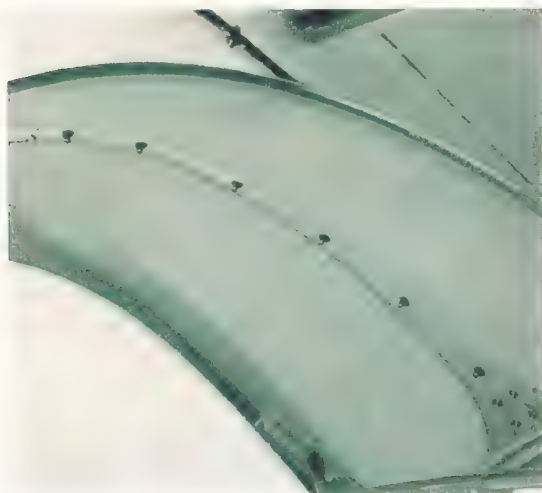
Leaks at the windshield and at the rear window of the Coupé can be eliminated in the following manner:

Use a wooden wedge to lift the weatherstrip lip inside the car as far as possible and force Genuine VW Window Cement between weatherstrip and the body flange. Remove any surplus cement with denatured alcohol.

## Removal and Installation of Front Hood Moulding, Emblem and VW Sign

### Removal

- 1 - Remove the moulding clip gaskets.
- 2 - Push the clips through the holes from underneath the body and take off the moulding.
- 3 - Bend up the emblem retaining tongues and take off gaskets, emblem and base plate.
- 4 - Bend up the three VW sign retaining tongues, pull off the gaskets and remove VW sign.



### Installation

Reverse the preceding operations, while observing the following points:

- 1 - Replace bent or damaged moulding clips. Replace VW sign and emblem if retaining tongues have broken off.
- 2 - Cement the VW sign and emblem gaskets into place under the hood using VW Compound D 12, and bend down the retaining tongues.
- 3 - Push the gaskets over the moulding clips and cement them into place, using VW Compound D 12.

## Moulding on Cowl Side Panel

### Removal

- 1 - Raise the front hood and remove the moulding clip gaskets. Push the clips through the holes from the inside and take off the moulding.

### Installation

- 1 - Bent or damaged moulding clips should be replaced.
- 2 - Push the gaskets over the moulding clips and cement them into place, using VW Compound D 12.

## Door Moulding

### Removal

- 1 - Remove regulator and door handles.
- 2 - Remove door trim panel.
- 3 - Pull off moulding clip gaskets.
- 4 - Push out moulding clips through the holes from inside and take off the moulding.

### Installation

- 1 - Bent or damaged moulding clips should be replaced.
- 2 - Push the gaskets over the moulding clips and cement them into place, using VW Compound D 12.



## Rear Quarter Panel Moulding

### Removal

- 1 - Remove rear quarter trim panel.
- 2 - Pull off moulding clip gaskets.
- 3 - Push the clips through the holes from inside and take off the moulding.

### Installation

- 1 - Damaged or bent moulding clips should be replaced.
- 2 - Push the gaskets over the moulding clips and cement them into place, using VW Compound D 12.

## Outside Rear View Mirror (Passenger Cars)

From Chassis No. 1 329 017 each Passenger Car for the inland market is provided with an outside rear view mirror as standard equipment. The mirror is placed in the glove compartment to avoid damage on transit.

Prior to delivery, the mirror should be mounted on the left-hand door hinge pin so that the mirror rod is approx. at right angles to the longitudinal car axis. The cap nut should never be tightened to a torque of more than 1 mkg (7 ft. lbs.).

The following SP Sets are available for subsequent installation:

**VW Sedan SP 96; VW Convertible SP 97.**

It is recommended to insert the hinge pin for the mirror with a hollow drift or a piece of suitable tube to prevent damage to the threaded end.

Left-hand drive cars that go for export are not provided with an outside rear view mirror as

standard equipment, but the upper door hinge of the left-hand door has a hinge pin with cap nut (Part No. 113 831 433) to allow an easy installation of the mirror on request. Right-hand drive cars continue to be provided with the usual hinge pins.



## Outside Rear View Mirror (Karmann Ghia Models)

Commencing at Chassis No. 1 323 910 each Karmann Ghia Coupé and Convertible for the inland market is provided with an outside rear view mirror as standard equipment. The mirror is placed in the glove compartment to avoid damage on transit.

Prior to delivery of the Coupé, the mirror should be mounted above the left-hand front fender where two holes are provided for the studs.

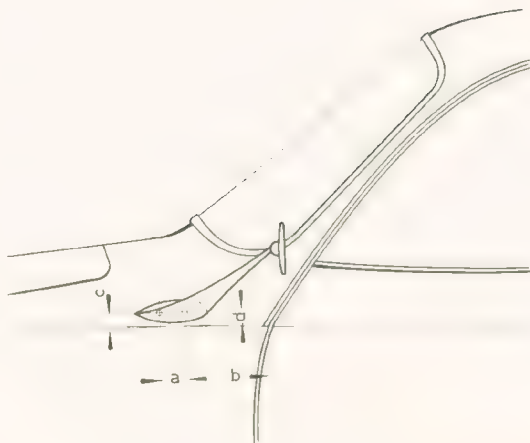
- 1 - To gain access to the fixing holes from below the car, remove the cover plate at the left-hand wheel arch.

- 2 - Place the mirror in position, interposing the rubber seal between the mirror base and the body.
- 3 - From below the car, place the reinforcement plate over the studs and tighten the nuts against the lock washers.
- 4 - When reinstalling the cover plate at the wheel arch, care should be taken that the rubber strip is properly positioned to insure a perfect seal.

SP Set 98 includes all parts required for a service installation:

Outside mirror	Part No. 141 857 513
Rubber seal	Part No. 141 857 539
Reinforcement plate	Part No. 141 857 541
2 Nuts	Part No. N 11 006 2
2 Lock washers	Part No. N 12 006 2

For a service installation, two 6.5 mm (.26") dia. holes are to be drilled at right angles to the body panel as specified on the drawing. Mount the mirror as detailed above after having removed the burr from the hole edges.



a = 45 mm (1.77")  
b = 96 mm (3.78")

c = 32 mm (1.26")  
d = 33 mm (1.30")

## Front Seat Removal and Installation

### Removal

#### De Luxe Model

- 1 - Lift the adjusting handle and slide the seat forward until it can be lifted from the seat runners.



- 2 - Take out the seat.

#### Standard Model

- 1 - Remove the two wing nuts and take off the seat clamps.



- 2 - Take out the seat.

### Installation

Reverse the preceding operations.

With the De Luxe Model, grease the seat runners with VW Universal Grease A-052 prior to installing the seat.

## Rear Seat Removal and Installation

### Removal

- 1 - Raise the seat cushion at the front and tilt it for removal.



- 2 - Remove the four attaching screws at the seat back anchor points and lift out the back toward the front.

### Installation

Reverse the removal procedure while observing the following points:

- 1 - Check condition of the rear seat back rubber buffers, replace as necessary.
- 2 - Check condition of rubber strips on the support brackets, renew as necessary.
- 3 - Push the rear seat cushion as far toward the rear as is necessary to position the retaining plates behind the support brackets.



## Front Seat Removal and Installation

### Removal

#### De Luxe Model

- 1 - Lift up locking mechanism on the right hand side of the seat and slide the seat forward until the retaining spring on the left side of the seat and the seat frame can be disengaged. Then push the seat further forward and take it out of the guide rails.



- 2 - Take out the seat.

#### Note:

When interchanging the front seats the adjusting mechanism must also be taken out and reinstalled at the proper side. The adjusting cams with wings must always point outward. Grease the seat runners with VW Universal Grease A-052 prior to installing the seat.

#### Standard Model

- 1 - Remove the two wing nuts and take off the seat clamps.
- 2 - Remove the seat.

### Removal and Installation of the adjusting cams

- 1 - Remove seat.
- 2 - Remove the pin from the left or right hand adjusting cam by means of a punch.



- 3 - Remove cam.

- 4 - Remove the opposed cam with connecting tube from the guide tube.

#### Note:

The adjusting cams of the front seats are not interchangeable.

Installation is a reversal of the preceding operations. Prior to installation the cams should be lightly greased on the friction side to the guide tube with Genuine VW Universal grease A - 052.

#### Note:

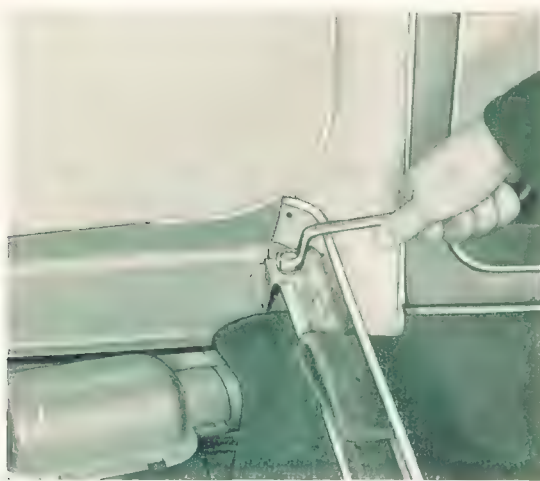
The stop plates for the front seat back rests on the Standard Model are also secured by a pin at the rear cross tube.

## Rear Seat Removal and Installation

(From August 1955)

### Removal

- 1 - Push the seat cushion slightly backward, raise it and take it out from its support.
- 2 - Remove seat cushion diagonally.
- 3 - To remove the seat cushion support, raise the felt strip at the two ends of the rail and remove the two hex. screws.



- 4 - Disengage the loop at the right hand top corner of the backrest.
- 5 - Remove the two back rest securing screws and take out back rest towards front.



### Installation

Reverse the removal procedure while observing the following points:

- 1 - Check condition of rubber buffers on the backrest stops, replace if necessary.
- 2 - Check condition of the felt strip and the three felt pieces at the inside of the cushion support and replace if necessary. The three felt pieces prevent the seat cover from chafing against the support.
- 3 - When installing the rear seat cushion, it must be pushed back until its lower edge fits behind the vertical portion of the support. Push seat cushion down until it squarely fits in the support. Do not apply force as the seat covers will get damaged.

#### Attention!

Rear seat cushion and backrest of previous design (before August 1955) cannot be exchanged for those produced at a later date.

## Seats (Karmann Ghia Models)

### Front seat cushion frame

From October 2nd, 1950, Chassis No. 1304088 the sturdiness of the seat cushion frame has been improved by the following alterations:

- 1 - The length of the reinforcement tube in the seat cushion frame has been increased from 100 to 300 mm (3.937" to 11.811").
- 2 - The welded joint at the seat frame is no longer situated 20 mm (.787") in front of but below the backrest.

### Subsequent installation of a reinforcement plate for the seat cushion frame (up to Body No. 9199).

When repairing a bent or broken seat frame (at the point indicated by "e" on the drawing) proceed as follows:

- 1 - Remove backrest.

- 2 - Loosen cover and spring assy.

- 3 - Remove spring assy with padding and cover.

- 4 - Straighten seat frame.

- 5 - Weld reinforcement plate (A) to the inside of the seat frame as specified on drawing.

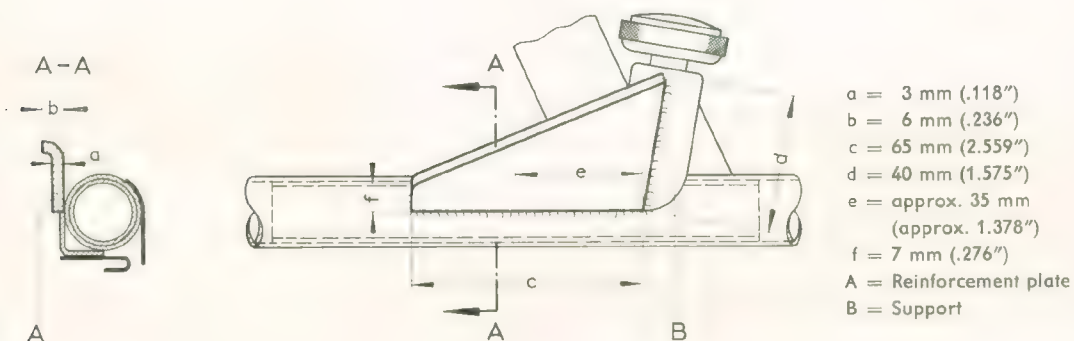
- 6 - Paint welded spots and reinforcement plate.

- 7 - Fasten spring assy with padding and cover to seat frame.

- 8 - Fasten cover and sew it up.

- 9 - Install backrest.

Be careful not to damage the thread on the inside when welding the reinforcement plate to the backrest adjustment support "B".



### Front seats

W. e. f. September 16th, 1957, Chassis No. 1649253, the Karmann Ghia Coupé has been provided with three-position rake adjusting cams for the front seats in place of the screws used previously. Thus easy rake adjustment is possible even while driving.

The upholstery at the front edge of the seats has been strengthened for better leg support. To

improve seating comfort, the front seats have been provided with a synthetic foam padding.

Seats of previous design may be exchanged for those of new design.

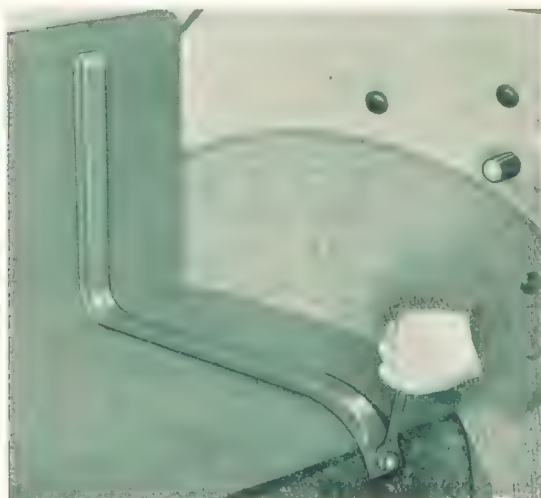
Service installation of the new rake adjustment on seats of previous design is not possible.



## Removal and Installation of Luggage Compartment Lining and Sound-Absorbing Pad

### Removal

- 1 - Remove rear seat and rear seat back.
- 2 - Remove the two lining retainer screws.



- 3 - Unhook the lining retainers.
- 4 - Take off the luggage compartment lining. (De Luxe: Carpet. Standard: Cardboard.)
- 5 - Remove the sound-absorbing pad. The pad is cemented in place and will generally suffer damage during removal. If welding jobs are to be carried out, all traces of the pad and the cement should be removed, as those materials are burnable.

### Installation

Installation is effected by reversing the removal procedure but the following points should be observed:

- 1 - Before cementing the sound-absorbing pad into place, thoroughly remove all traces of the old pad and cement. It is recommended to use benzine as a solvent.
- 2 - Cement the sound-absorbing pad into place, using VW Compound D 12. Best results are only obtained, if the pad makes complete contact with the luggage compartment panel.
- 3 - Push the luggage compartment lining behind the upper edge of the sound absorbing pad.
- 4 - Engage the retainers with the noses provided on the luggage compartment panel.



## Rear Wheel Housing Carpet

### Removal

- 1 - Remove rear seat and rear seat back.
- 2 - Carefully pull off the carpet to avoid damage.

### Installation

Reverse the removal procedure while observing the following points:

- 1 - Before cementing the carpet into place, thoroughly remove all traces of the old cement. It is recommended to use benzine as a solvent.
- 2 - Cement the carpet into place, using VW Compound D 11.

De Luxe Model: The luggage compartment lining (carpet) must overlap the wheel housing carpet.

## Rear Quarter Trim Panel Removal and Installation

### Removal

- 1 - Prise off the rear quarter trim panel from the rear quarter inner panel.
- 2 - The moulding on the De Luxe can be removed after having bent up the clips.
- 3 - If required, remove the insulation pad.

### Installation

This is a reversal of the operations described above, but attention should be paid to the points below:

- 1 - Prior to cementing the insulation pad into place, carefully remove all traces of the old

cement. It is recommended to use benzine as a solvent.

- 2 - Cement the insulation pad into place, using VW Compound D 11.
- 3 - With the De Luxe: Remove damaged or broken moulding clips. Reinstall the moulding and bend down the clips.
- 4 - When reinstalling the rear quarter trim panel, make sure that the oiled paper at the bottom overlaps the inner panel to allow the water to drain.

## Body Side Member Carpet Removal and Installation



### Removal

- 1 - Pry up the carpet retaining flange.
- 2 - Remove the tacks and pull off the carpet.

### Installation

- 1 - Prior to cementing the carpet into place, carefully remove all traces of the old cement. It is recommended to use benzine as a solvent.
- 2 - Cement the carpet into place, using VW Compound D 11.
- 3 - Bend down the carpet retaining flange.
- 4 - Apply a tack at the front end of the carpet.

## Cowl Panel Carpet Removal and Installation

### Removal

The three cowl panel carpets are tacked in position at the upper corners. For removal of the right and left carpets, the tacks at the front end of the side member carpets should also be removed.

### Installation

- 1 - Prior to cementing the carpets into place, carefully remove all traces of the old cement. It is recommended to use benzine as a solvent.
- 2 - Cement the carpets into place, using VW Compound D 11. Be sure the carpets make perfect contact with the cowl panel.
- 3 - Apply tacks at the upper corners.

## Frame Tunnel (Backbone) Carpet Removal and Installation

### Removal

- 1 - Lift up the rear seat cushion.
- 2 - Take out the rubber mats.
- 3 - Remove heating control knob.
- 4 - Pull off the frame tunnel carpet (Standard Model: rubber mat at front, carpet at rear end).
- 5 - De Luxe Model: If necessary, also remove the hand brake lever boot.

### Installation

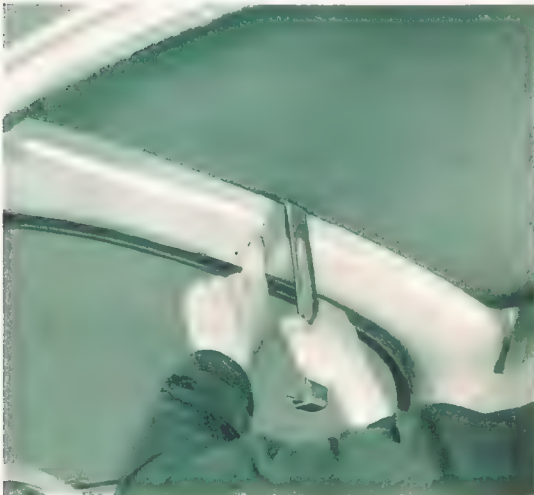
This is a reversal of the operations described above, but attention should be paid to the points below:

- 1 - Prior to cementing the carpet into place, carefully remove all traces of the old cement. It is recommended to use benzine as a solvent.
- 2 - Cement the carpet into place, using VW Compound D 11.

## Headlining Removal and Installation

### Removal

- 1 - Remove rear view mirror.
- 2 - Push the cardboard strip at the headlining front end towards the front to allow the tool VW 366 to be inserted between the roof member and the headlining. This can be done with one finger through the hole in the roof member.



- 3 - Move the tool VW 366 along the front roof member, at the same time lifting out the front edge of the headlining.
- 4 - Reinsert the tool behind the corner of a door hinge pillar and move it up to the first bow. Lift the bow with one hand and continue to move the tool along the roof side member up to the rear end.



- 5 - After the headlining has been released on one side, pull out the bows on this side.
- 6 - Insert the tool behind the corner of the other door hinge pillar and repeat the above operation.
- 7 - In the same manner, move the tool along the rear side of the headlining and remove the headlining and bows as one unit.
- 8 - If necessary, remove the roof insulation.

### Installation

This is a reversal of the preceding operations, but attention should be paid to the points below:

- 1 - Prior to cementing the roof insulation pad into place, carefully remove all traces of the old felt and cement. It is recommended to use benzine as a solvent.
- 2 - Cement the roof insulation pad into place, using VW Compound D 11.



3 - Reinstall the headlining and bows starting from the, rear. Position the tool VW 366 between the cardboard strip and the headlining cloth and

press down the cardboard strip until it is held back by the roof member flange.

## Glove Compartment Removal and Installation

### Removal

1 - Raise the front hood and remove the retaining strap screw. Take off the glove compartment.



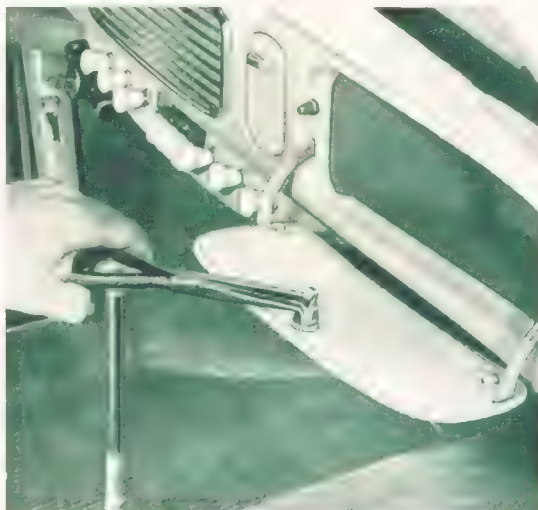
2 - Remove the two screws at the lid check straps and take off the lid.



3 - Remove the two screwed rivets of the lid check straps and pull out the check straps toward the front.

4 - Remove the two rubber plugs from the glove compartment frame.

5 - Screw out the lid lock, using the circlip pliers VW 122 b.



### Installation

Reverse the removal procedure while observing the following points:

1 - When tightening the glove compartment retaining strap, take care that the glove compartment is correctly positioned against the instrument panel. Leaks between the glove compartment and the instrument panel should be eliminated by means of sticky tape.

2 - Check condition of rubber plugs. Replace if necessary.

3 - Check the lid alignment by opening and closing the lid repeatedly.

4 - Apply a few drops of oil to the lid lock.

5 - Should it be found necessary, bend the lock plate into the required position.

## Sound Proofing

(Karmann Ghia Models)

On 19. 6. 1957, Chassis No. 1 649 153, two measures were introduced to improve sound deadening on the Karmann Ghia Coupé. A glass wool mat of 12 mm (.472") thickness has been placed between the engine compartment partition panel and the sound deadening cardboard. The sound deadening cover on the two rear wheel arches in the luggage

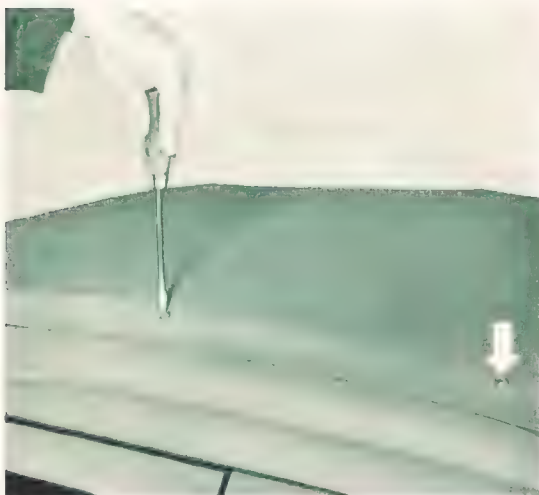
compartment has been replaced by a more thickly impregnated felt cover with a special sound absorbing layer.

Vehicles of older version may be provided with the glass wool mat (Part No. 141 813 803) and the two covers (Part No. 141 813 821/822) if desired.

## Top Cover Removal and Installation

### Removal

1 - Remove the four countersunk screws and washers.



3 - Push the sliding roof to the half-open position and remove the two screws that attach the top cover bow to the locking bow. Swing back the top cover.



2 - Remove the four concealing strips from the guide bows.



4 - Swing back the two side straps after having removed the strap retaining screws on the locking and guide bows.





- 5 - Remove the 11 countersunk screws from the top cover and side strap retainer at the rear and take off top cover and side straps.



### Installation

Installation of the top cover is effected by reversing the removal procedure, but attention should be paid to the following points:

- 1 - Apply some vaseline to the side guide rails and sliding roof lock.
- 2 - Make sure the side straps are fitted correctly. The black sides of the straps must face downward.
- 3 - When using new screws for attaching the top cover to the locking bow, check them for free movement in the locking bow before installation. Coat the screws with grease.
- 4 - Install the concealing strips in their original position.

### Note:

To adjust the tension of the top cover, open the sliding roof a bit and loosen the retainer screws at the back. Push the top cover a few millimeters toward the rear and retighten the retainer screws. Check top cover tension by opening and closing the sliding roof repeatedly.

## Side Guide Rail Removal and Installation

### Removal

- 1 - Push the sliding roof to the half-open position and remove the 10 screws from the front guide rail and the two screws from the rear guide rail.



- 2 - Take off the rear guide rail.

- 3 - Fully open the sliding roof so that the front side rail is free.
- 4 - Pull off the front guide rail and the plastic bead toward the front.
- 5 - Bend up the nose at the front end of the guide rail and pull out the bead.
- 6 - Remove the weather strip.

### Installation

The installation is accomplished by reversing the removal procedure, but the following points should be observed:

- 1 - Removal all traces of the old cement from the edge of the roof opening.
- 2 - Cement new weather strip into place, using VW Compound D 11.
- 3 - Check the guide rail bead for damage. Install the bead and bend down the nose at the front end of the guide rail.
- 4 - Install the front guide rail and slide the bow guide pieces into the rail.
- 5 - Install the rear guide rail.
- 6 - Lightly coat the guide rails with vaseline.

## Lock and Stretcher Mechanism Removal and Installation

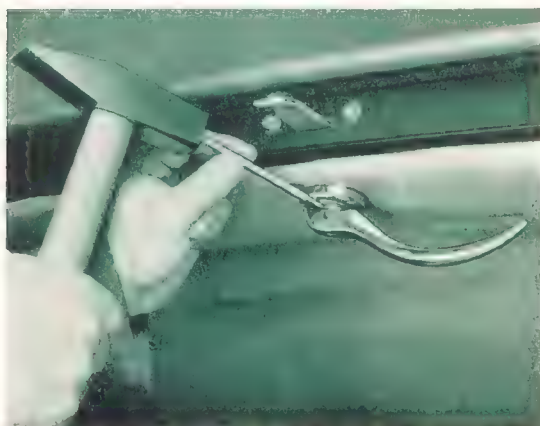
### Removal

- 1 - Remove the screws that attach the top cover and side straps and swing back top cover and side straps.
- 2 - Remove the three countersunk screws from each locking bow guide plate and take off the guide pieces.

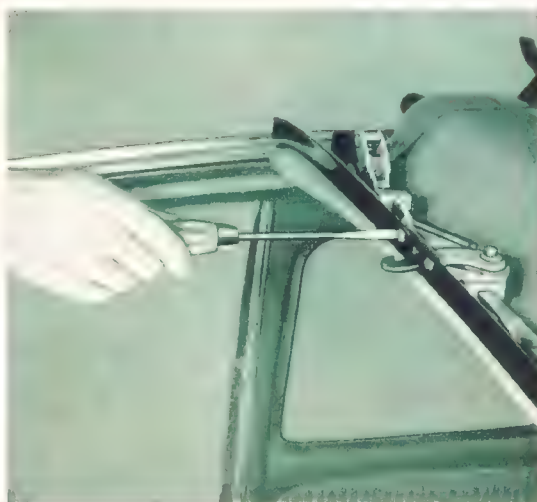


- 3 - Remove the two hex. screws from each locking bow guide plate and swing back the locking bow guide plates.

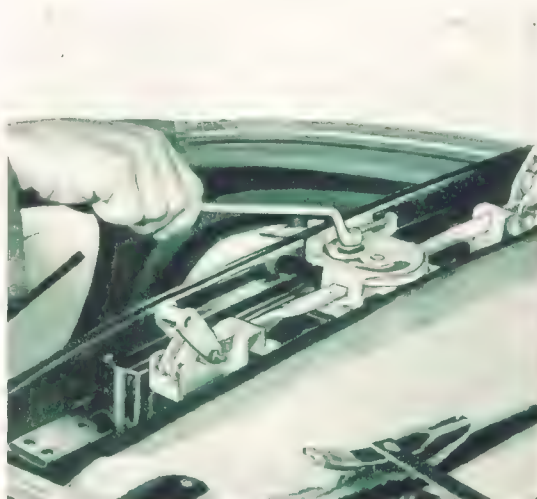
- 4 - Press the escutcheon plate against the locking bow and drive out the pin. Take off handle, escutcheon plate, spring and rubber insert.



- 5 - Remove the two cylindrical screws at the lock.

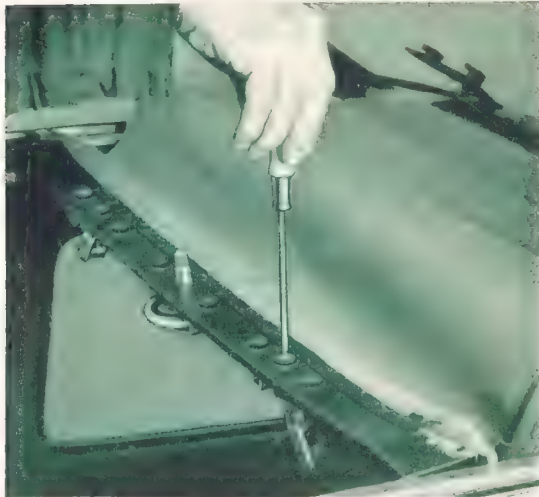


- 6 - Remove the screw at the locking hook, lift the hook and push it rearward.



- 7 - Turn the locking bow by 180 deg. and remove the eight countersunk screws holding the lock

and stretcher mechanisms. Take off the lock and stretcher mechanisms.



## Installation

The installation is a reversal of the removal procedure, but the following points should be observed.

- 1 - Grease all moving parts of the lock with vaseline.
- 2 - Do not overtighten the locking hook screw to ensure a free movement of the hook.
- 3 - If the locking hook jams in the slot when closing the sliding roof, loosen the two hex. screws at each locking bow guide plate. Shift the guide plates in their slotted holes until the sliding roof can be opened and closed without difficulty.
- 4 - After assembly, check locking mechanism for proper functioning by opening and closing the sliding roof repeatedly.

## Headlining Removal and Installation

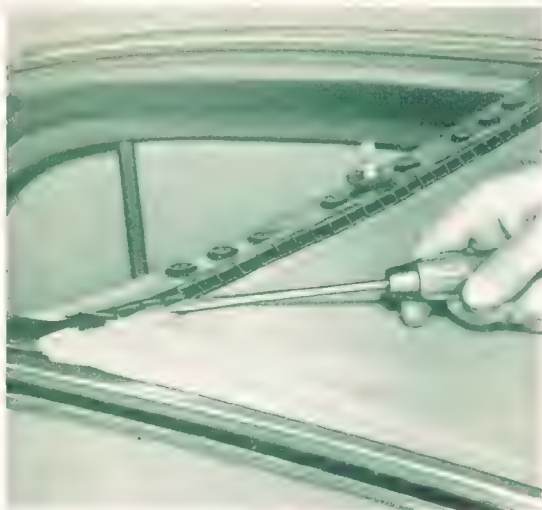
### Removal

- 1 - Remove the screws that attach the top cover and side straps and swing back top cover and side straps.
- 2 - Remove the three countersunk screws from each locking bow guide plate and take off the guide pieces.
- 3 - Remove the two hex. screws from each locking bow guide plate and swing back the locking bow guide plates.



- 4 - Remove handle and escutcheon plate, spring and rubber insert.

- 5 - Remove the four countersunk screws that attach the headlining to the guide bows of the sliding roof.
- 6 - Turn the locking bow by 180 deg. and remove the two hollow rivets, one on each end of the locking bow.
- 7 - Bend up the headlining retaining strip and withdraw the headlining from the locking bow.





- 8 - Remove the rivets that attach the struts to the flat bows and pull out the flat bows.



- 9 - Remove the two hollow rivets, one at each rear corner of the roof opening.

- 10 - Pry off the rear trim panel and tear off the headlining from the rear edge of the roof opening.



#### Installation

Install the headlining in the reverse order while observing the following points:

- 1 - Remove all traces of the old cement from the rear edge of the roof opening, using benzine as a solvent.
- 2 - Cement the headlining to the rear edge of the roof opening, using VW Compound D 11.
- 3 - After the headlining has been attached to the locking bow, first check the tension of the headlining by closing the sliding roof. If found necessary, again detach the headlining from the locking bow and position the headlining further forward or rearward.

## Guide Bow Removal and Installation

#### Removal

- 1 - Remove the screws that attach the top cover and side straps and swing back top cover and side straps.
- 2 - Remove the two screws that attach the headlining to the guide bow.
- 3 - Remove the female screws on each end of the guide bow. Lift the struts a bit and remove guide bow, guide plate, anti-rattle and rubber cushion.

#### Installation

The guide bow is installed in the reverse order, but the following points should be observed:

- 1 - Position the guide plates on the correct sides.
- 2 - Place two rubber rings into the guide plate.
- 3 - Adjust at the female screws if the guide bows rattle of the pressure on the rubber cushions is excessive.

## Roof Cover Removal and Installation

### Removal

- 1 - Release the roof lock.
- 2 - Remove the two screws at the headlining, one screw on each side.



- 3 - Pull the headlining away from the roof edge and remove the two bow link screws from the roller plate.

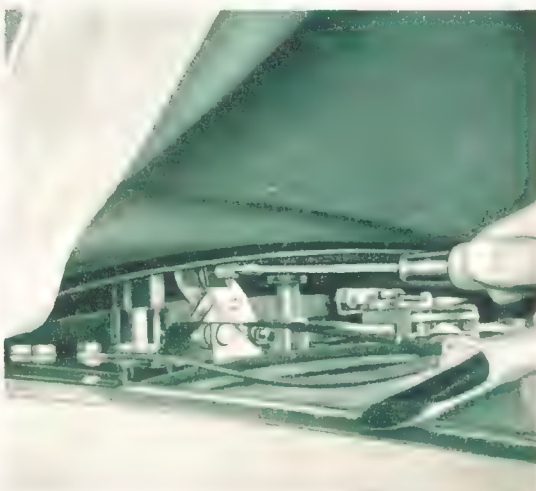


- 4 - Remove the two roller plate attaching screws and take off the roller plate, one on each end of the guide bow.
- 5 - Push the roof half open. Pull the single rollers from the roof cover and remove the guide bow.

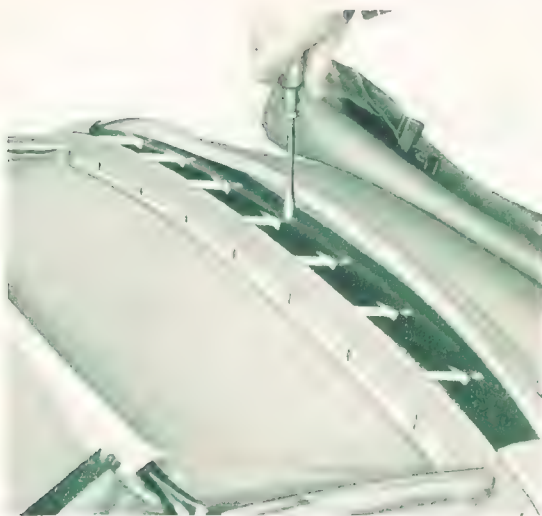


- 6 - Detach the ends of the two flat bows from the roof cover.

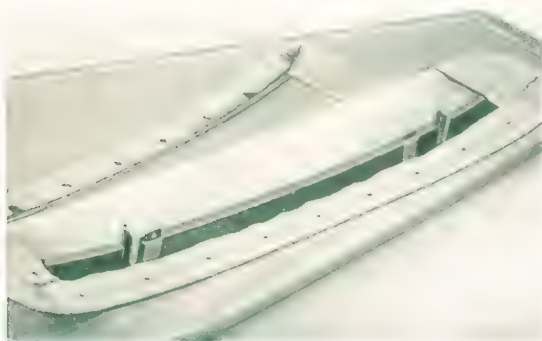
- 7 - Remove the two roof cover bow anchor bolts from roof locking bow. Lift up the roof cover bow and fold the roof cover rearward.



- 8 - Remove the nine countersunk screws (two of them being concealed by the cover) from the roof cover slat iron at the rear of the roof opening, and take off roof cover and roof cover bow.



9 - Remove the rivets that attach the roof cover to the roof cover bow.



## Installation

Reverse the removal procedure and observe the following points:

- 1 - Apply some vaseline to the moving parts of roof locking mechanism.
- 2 - When using new roof cover bow anchor bolts, make sure they freely move in the roof cover bow and the corresponding holes in the locking mechanism before installing them. Grease the anchor bolts.
- 3 - Properly insert flat bows and guide bow rollers into the roof cover flaps.
- 4 - Attach the roller plates slightly preloaded to the guide bow so that the single rollers (vertically pivoted) and the roller pairs (horizontally pivoted) freely run in the guide rail without perceptible play.

## Note:

- 1 - The plastic material of the roof cover renders a re-adjustment of the roof cover tension unnecessary.
- 2 - The sliding roof of the type installed from August 1955 requires no service attention. Prior to installing the sliding roof, it is, however, recommended to apply a drop of oil to the roller pivots. The guide rails must **not** be greased.

# Locking Mechanism Removal and Installation

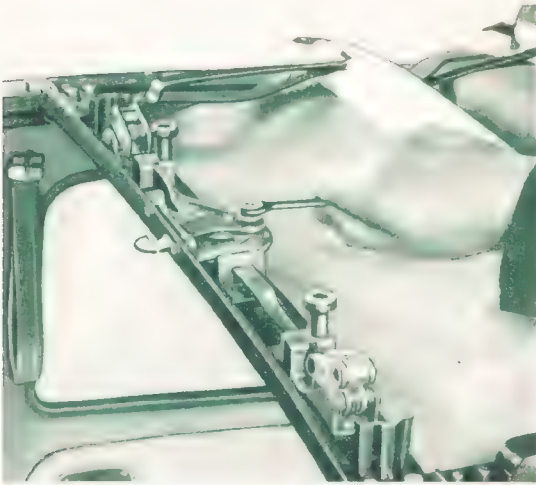
## Removal

- 1 - Release the roof lock and slightly open the roof.
- 2 - Press the escutcheon plate against the locking bow and drive out the pin. Take off handle, escutcheon plate, spring, and rubber inserts.

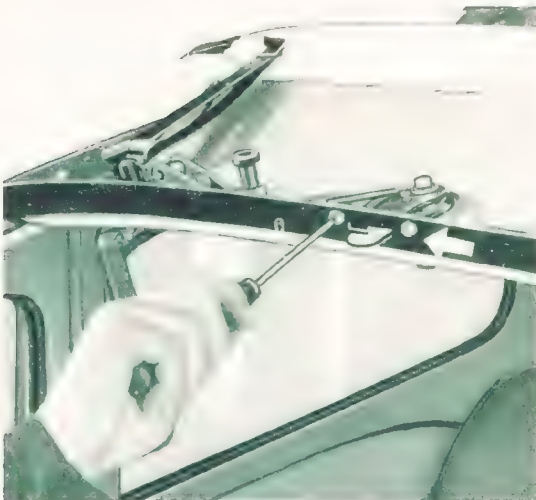




- 3 - Remove guide and flat bows.
- 4 - Detach roof cover bow from locking bow and fold the roof cover rearward.
- 5 - Unhook the roof lock spring.
- 6 - Remove the locking hook screw, lift the hook off its pivot and push it rearward for removal.

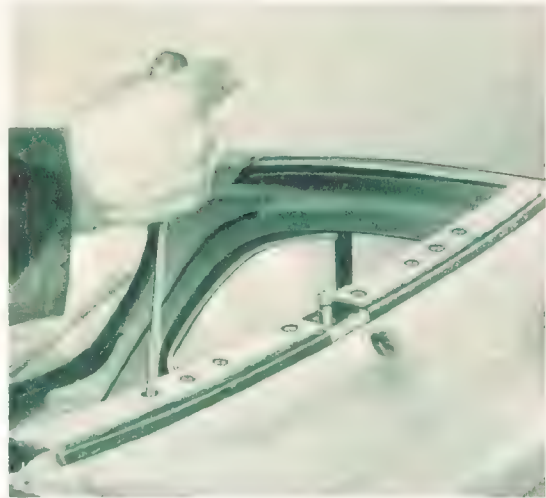


- 7 - Remove the two lock attaching screws.



- 8 - Detach locking bow from the roller plates on both sides and turn the locking bow 180 degrees (upside down).

- 9 - Remove the eight screws holding the locking mechanism and take off complete locking mechanism.



### Installation

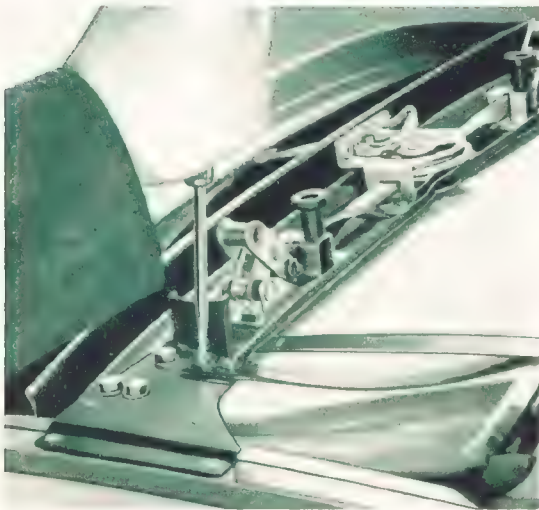
Reverse the removal procedure and observe the following points:

- 1 - Apply some vaseline to the moving parts of roof locking mechanism.
- 2 - Tighten locking hook screw to a degree which assures a free movement of the hook.
- 3 - If the locking hook jams in the slot when closing the sliding roof, loosen the hex. screws of the roller plates. The locking bow can then be moved laterally in the slotted holes of the roller plates to enable the sliding roof to be locked and unlocked without difficulty.
- 4 - New roof cover bow anchor bolts are to be checked for free movement in the corresponding holes of roof cover bow and locking bow. Lightly grease the anchor bolts.
- 5 - Properly install guide and flat bows and make sure the rollers move freely in the guide rail without perceptible play.
- 6 - The locking handle must point toward the right-hand door (at right angles) when the roof is locked.
- 7 - After installation, check locking mechanism for proper functioning by opening and closing the sliding roof repeatedly.

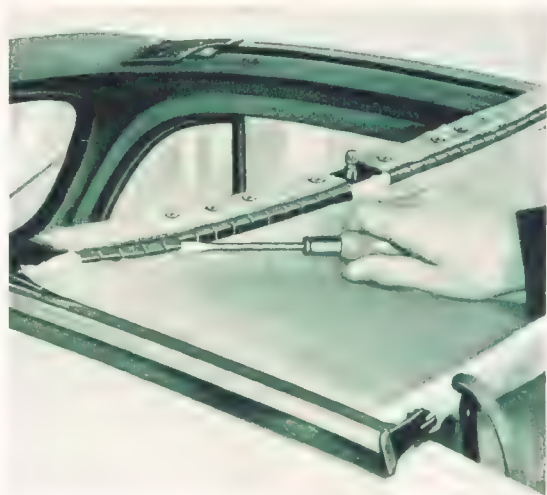
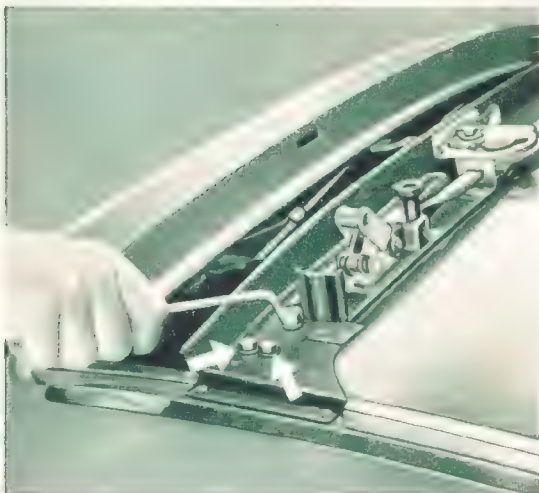
## Headlining Removal and Installation

### Removal

- 1 - Open the roof.
- 2 - Remove locking handle, escutcheon plate, spring, and rubber insert.
- 3 - Remove guide bow.
- 4 - Detach the flat bow ends from roof cover. Remove the two roof cover bow anchor bolts from roof locking bow and fold the roof cover rearward.
- 5 - Remove the screws that attach the front bow links to the locking bow roller plates.
- 7 - Turn the locking bow 180 degrees (upside down).
- 8 - Remove the two rivets, one on each end of the locking bow.
- 9 - Pry up the headlining retaining strip and pull the headlining away from the locking bow.



- 6 - Remove the screws that attach the roller plates to the locking bow.

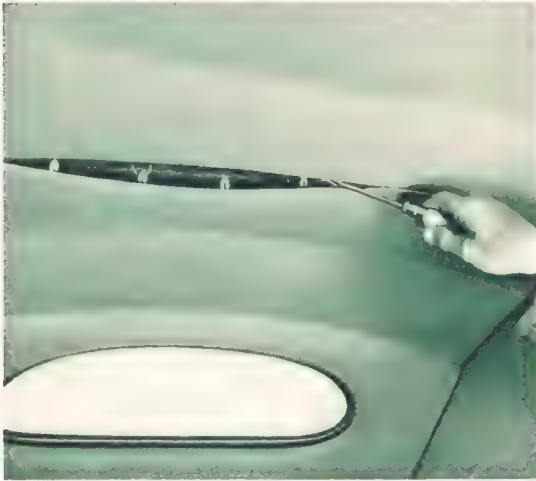


- 10 - Remove the rear guide rails.

- 11 - Remove the two rivets, one in each rear corner of the roof opening.



- 12 - Pry off the rear trim panel and tear off the headlining from the rear edge of the roof opening.



- 13 - Lift off the headlining and remove the rivets that attach the bow links to the flat bows. Pull out the bows.

### Installation

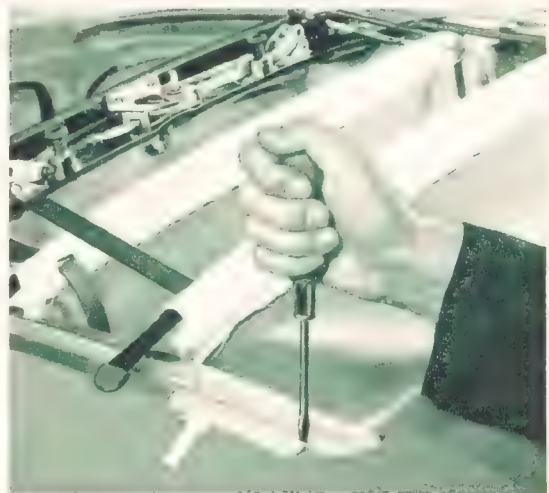
Install the headlining in the reverse order, while observing the following points:

- 1 - Remove all traces of the old cement from the rear edge of the roof opening and from the locking bow, using benzine as a solvent.
- 2 - Cement the headlining to the rear edge of the roof opening, using VW Compound D 11.
- 3 - After the headlining has been attached to the locking bow, first check the tension of the headlining by closing the sliding roof. If found necessary, again detach the headlining from the locking bow and position the headlining further toward the front or rear.
- 4 - Cement the headlining to the locking bow, using VW Compound D 11, bend down the retaining strip, and rivet the headlining corners to the locking bow.
- 5 - Apply vaseline to the moving parts of the locking mechanism.
- 6 - New roof cover bow anchor bolts are to be checked for free movement in the corresponding holes of roof cover bow and locking bow. Lightly grease the anchor bolts.
- 7 - Properly install flat bows and guide bow and make sure the rollers move freely in the guide rails without perceptible play.
- 8 - After assembly, check locking mechanism for proper functioning by opening and closing the sliding roof repeatedly.

## Guide Rail Removal and Installation

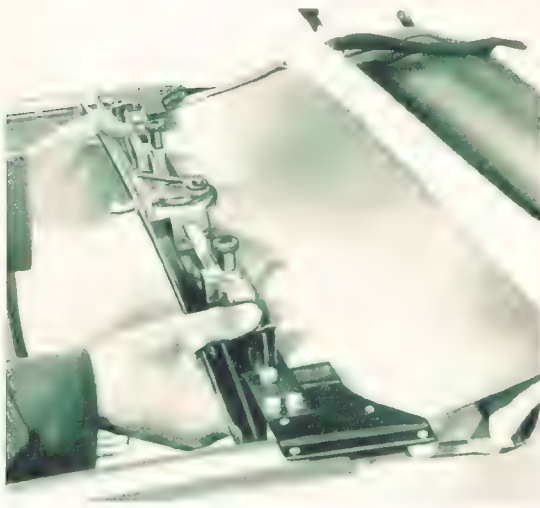
### Removal

- 1 - Open the roof.
- 2 - Remove locking handle, escutcheon plate, spring, and rubber insert.
- 3 - Remove guide bow.
- 4 - Detach the flat bow ends from roof cover. Remove the two roof cover bow anchor bolts from roof locking bow and fold the roof cover rearward.
- 5 - Remove the screws that attach the front bow links to the locking bow roller plates.
- 6 - Remove the countersunk screws which hold the rear guide rails, and take off the rails.





- 7 - Push locking bow and headlining rearward and lift locking bow out of the roof opening.



- 8 - Remove the countersunk screws which hold the front guide rails, and take off the rails and anti-squeak strips.

#### Installation

Reverse the removal procedure and observe the following points:

- 1 - Place the anti-squeak strips in position.
- 2 - After installation of front guide rails, slide the locking bow forward.
- 3 - When installing rear guide rails, make sure that they are flush with the front guide rails.
- 4 - Properly install flat bows and guide bow and make sure the rollers move freely in the guide rails without perceptible play.
- 5 - After assembly, check locking mechanism for proper functioning by opening and closing the sliding roof repeatedly.

#### Important

Never grease guide rails.

## Locking Bow Removal and Installation

### Removal

- 1 - Open the roof.
- 2 - Remove locking handle, escutcheon plate, spring, and rubber insert.
- 3 - Remove guide bow.
- 4 - Detach the flat bow ends from roof cover. Remove the two roof cover bow anchor bolts from roof locking bow and fold the roof cover rearward.
- 5 - Remove the screws that attach the front bow links to the locking bow roller plates.
- 6 - Remove rear guide rails.
- 7 - Push locking bow rearward until it clears the front guide rails and turn it 180 degrees (upside down).
- 8 - Detach headlining from locking bow.

### Installation

Reverse the removal procedure and observe the following points:

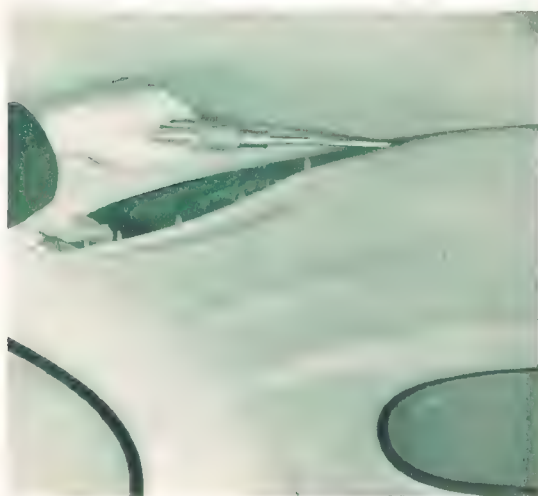
- 1 - When attaching the headlining to the locking bow, note proper tension of headlining.
- 2 - Make sure the rear guide rails are flush with the front guide rails.
- 3 - Apply vaseline to the moving parts of the locking mechanism.
- 4 - If the locking hook jams in the slot when closing the sliding roof, loosen the hex. screws of the roller plates. The locking bow can then be moved laterally in the slotted holes of the roller plates to enable the sliding roof to be locked and unlocked without difficulty.
- 5 - New roof cover bow anchor bolts are to be checked for free movement in the corresponding holes of roof cover bow and locking bow. Lightly grease the anchor bolts.
- 6 - Properly install guide and flat bows and make sure the rollers move freely in the guide rails without perceptible play.
- 7 - After installation, check locking mechanism for proper functioning by opening and closing the sliding roof repeatedly.

## Adjusting Roof Cover Tension

From Chassis No. 1 181 041, also the rear corners of the sliding roof cover are rounded off, and the cover retainer (slat iron) is provided with studs in lieu of the countersunk screws held by nuts welded to the inner side of the roof panel. The studs pass through slotted holes in the roof panel to allow the retainer and cover to be moved in the fore and aft direction. The retainer is fixed in position with nuts and lock washers from inside the car, a reinforcement strip being interposed between the washers and the roof.

### Working order

1 - Loosen rear headlining.



2 - Open sliding roof.

3 - Remove nuts from cover retainer studs.



4 - Move retainer forward or rearward to obtain a sufficient and equal tension of the cover.



5 - Tighten nuts to some degree.

6 - Close sliding roof and check tension of roof cover.

7 - Fully tighten nuts when cover is found to be in proper tension.

8 - Attach rear headlining.

### Note:

When exchanging earlier bodies or roofs for new ones (from Chassis No. 1 181 041) the sliding roof cover and the corresponding retainer can be re-used. The only adaption to be made is to drill two new holes into the roof to register with the outer holes in the retainer. The retainer is fixed with the earlier screws and the corresponding washers and nuts.

### Rattle

- a - Eliminate vertical play by bending the roller bracket (see arrow) until the two lower rollers come to bear against the guide rail and no play is perceptible.

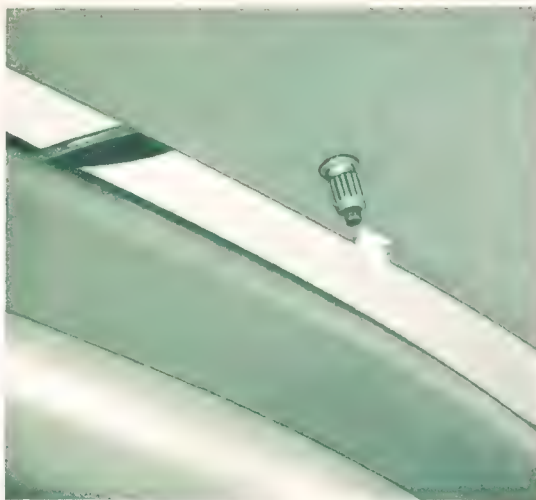
#### Note:

From Chassis No. 1 084 942 washers are provided as standard equipment between rollers and rivet head to decrease the clearance.



rails impossible and the cover properly folds when pushing the roof backward.

- c - In the case of a rattling handle, make sure the rubber insert is not missing. If found necessary, interpose a felt washer between bow and spring.



- b - The sliding roof bows are inserted into pockets of the now glued (D 12) cover flaps. This renders a rattling of the bows at the guide

### Stiffness

If undue force is required to turn the handle to the locked position, lessen the tension of the roof cover at the slat iron.





## Leaks

a - Leaks at the front edge of the sliding roof are attributable to the cover being in too much tension or the rubber strip under the cover bow front edge not correctly positioned. Excessive tension causes the cover bow to lift when closing the roof, leading to leaks. Lessening the tension of the top cover at the slat iron or regluing the rubber strip under the cover bow in position will cure the defect.

It may become necessary to straighten locking bows which are bent as a result of undue force applied in turning the handle to the locked position.

b - A piece of foam rubber is glued between the end of the guide rail and the slat iron on

either side to prevent ingress of water. Install these foam rubber pieces if found to be missing.





# The Convertible Top



## General

The Convertible top is supported by two frame side members, linkage and bows. The bows consist of wood and tubing. The top support is fastened to the body by two hinges at the two pillars.

The outer cover is of special water-proof cloth with rubberized underside. For interior trim and shape as well as for insulation against warmth and cold rubber hair matting is sewn on linen and fastened to the top support. All curves on the top have been rounded off with additional padding. The underside of the support is covered with a taut lining of tricot cloth.

When folded down the top is to be secured by two snap hooks.

## Lubrication

Regular lubrication as specified in the lubrication chart is of great importance for easy operation of the support linkage. All points to be lubricated should first be cleaned of dust and dirt.

## Care of the Convertible Top

The appearance and life of the top greatly depends on a proper care and maintenance.

The top must always be perfectly dry before lowering. When having driven the car on dusty roads, slightly beat out the top and brush the fabric in line with the lay of the thread by means of a soft brush, as the sharp foreign particles harm the top fabric if not quickly removed.

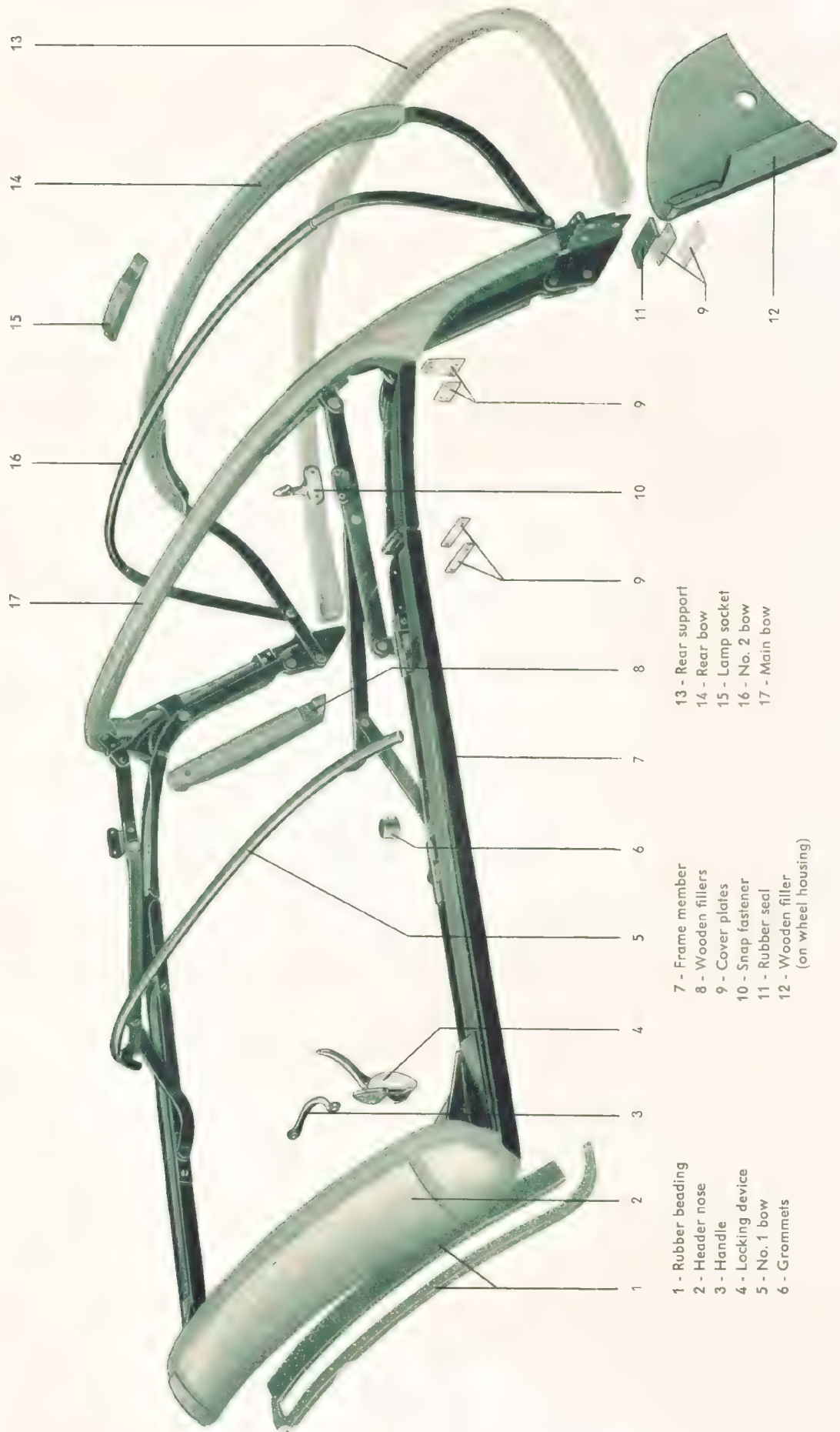
Damage due to friction may occur when the lowered top is not tightly held in position by the catches which engage in the slots cut in the side rails. In such cases, the catches should be screwed further into their retainers. To do this, the lock nuts are to be loosened before and tightened after the adjustment.

Spots can be removed from the material with an "art" gum eraser and brushed off with a whisk broom. Never use fuel or any other volatile cleaner, as they destroy the rubber ply in the top cover, leading to leaks and shortening the life of the top.

The top should be washed only when it is exceptionally dirty. Only use clear water which is free from chemical products or other additives. Prior to washing, beat out the top and then brush it off. Use luke-warm water and a mild soap, only such soap as castile or olive oil base soaps should be used. Moisten the top with clear water and apply the thick suds. Scrub the top with a soft brush. After scrubbing, flush off the suds with clear water. If necessary, repeat the scrubbing with suds. There should be no traces of the suds when the top has been flushed. Be sure the top is thoroughly dry before lowering.

After washing the top, clean the finish of the car by flushing with clear water and rubbing dry with a clean, soft cloth.

# Convertible Top Frame



- 1 - Rubber beading
- 2 - Header nose
- 3 - Handle
- 4 - Locking device
- 5 - No. 1 bow
- 6 - Grommets
- 7 - Frame member
- 8 - Wooden fillers
- 9 - Cover plates
- 10 - Snap fastener
- 11 - Rubber seal
- 12 - Wooden filler  
(on wheel housing)
- 13 - Rear support
- 14 - Rear bow
- 15 - Lamp socket
- 16 - No. 2 bow
- 17 - Main bow



## Installation of the Top

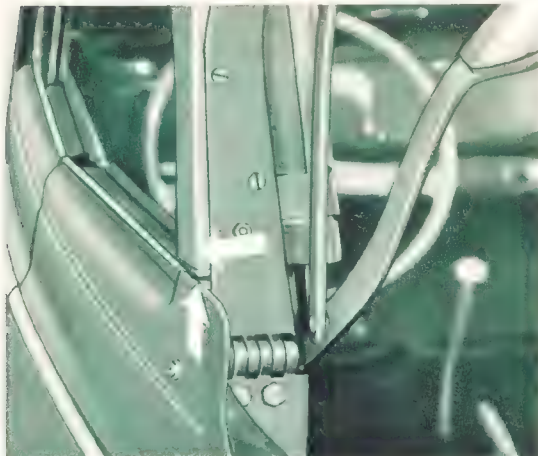
The following is a general description of the installation procedure. Work should in each case be carried out by an expert. Installation will be greatly facilitated if the job is carried out by two people. It is possible to install separate parts of the top individually.

### Installation of the Convertible top frame:

- 1 - Before installation of the top the carpets for the luggage compartment and rear wheel housings as well as all the seats must be removed. Lower the side windows.
- 2 - Put the frame for the top into position and fasten it loosely to the two pillars by 3 hex. screws at each side.



- 3 - Move the frame so far to the side that the wooden main bow is in line with the upper edge



of the body on the left and right, otherwise leaks might occur at these points. If the main bow

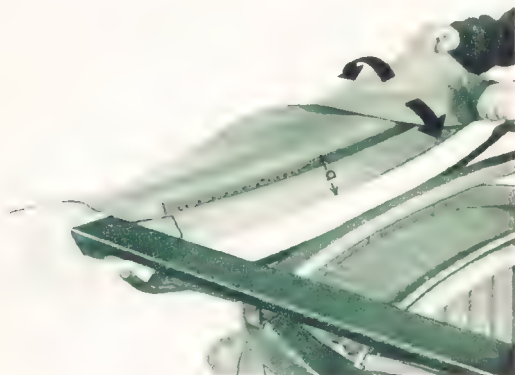
cannot be brought in line with the body it should be re-machined accordingly.

- 4 - Check for proper contact of the header nose on the windshield roof member. The rear part of the header nose should protrude by about 4 mm (.15") over the inner edge of the roof member toward the front as after installation and tightening of the top cover the frame becomes arched, thus pulling the header nose backward.
- 5 - Remove lamp socket for interior light and both wooden fillers from the main bow.
- 6 - Push the top frame toward the back.
- 7 - Cover the inside of the header nose with adhesive. Stick the sponge rubber (10 x 14 x 1350 mm) into the recess at the front edge and a strip of foam rubber (20 x 40 x 1250 mm) into the recess at the underside of the header nose. Cut the square sponge rubber piece so that it is slightly pointed at both ends.



- 8 - Nail a strip of top and head-lining material of about 1250 x 150 mm to the foam rubber covered underside of the header nose. Make sure that it is pulled tight towards the sides and nailed on about 60 mm away from the inner edge of the header nose. When doing this ensure that the outer sides of the folded cloth strips point outward.

- 9 - Nail 15—20 mm wide cardboard strips onto the cloth, strips, spacing them 80 mm apart. Coat header nose with adhesive. Fold the headlining to the inside and the top material to the outside.



$a = 80 \text{ mm}$

- 10 - Tighten headlining and top material, stick it on and nail it down. Slightly cut the headlining at the left and right corners to facilitate installation. Cut off the protruding cloth strips.

#### Important!

In order to protect the covers and strips from rust use tacks or pins made of brass only.

#### Note:

From Chassis No. 1 283 328

14 mm tacks, Part No. 151 871 473 and  
12 mm pins, Part No. 151 871 471  
made of brass are used as standard equipment.

This eliminates rust patches which were occasionally apparent on light-coloured tops.

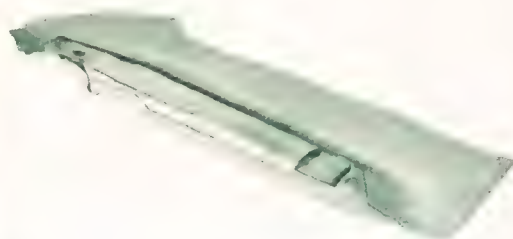
If necessary, replace the tacks used previously by brass tacks.

Rust patches can be removed as follows:

Mix one part of oxalic acid with 100 parts of warm water (70° C). In order to remove all acid from the fabric thoroughly rinse with clean water.

- 11 - Screw locking devices and handles left and right into the holes provided.

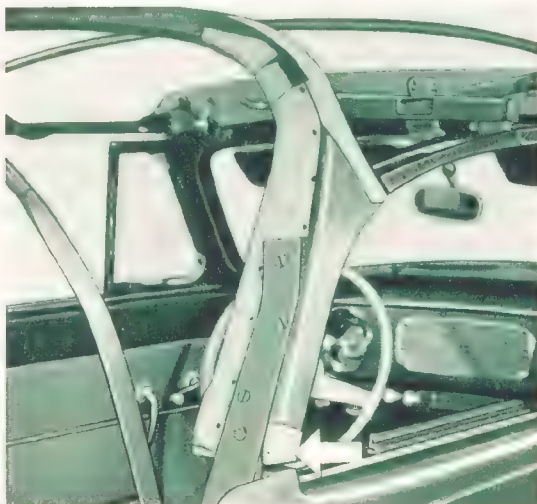
- 12 - Stick a piece of headlining (about 500 × 200 mm / 19.68" × 7.87") to the outside of each of the removed wooden filler pieces.



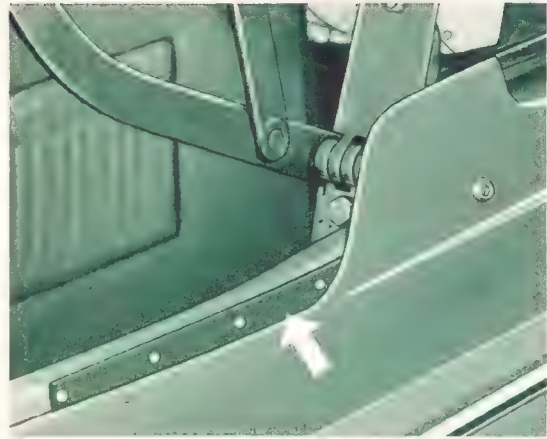
- 13 - Stick a piece of headlining (about 600 × 300 mm / 23.62" × 11.81") to each of the rounded-off sides of the wooden bow. Cut openings for the angle supports of the wooden fillers.

- 14 - Screw wooden fillers to the main bow. Wrap the protruding cloth around the lower part of the main bow, tighten and nail into place. Cut off surplus cloth strips.

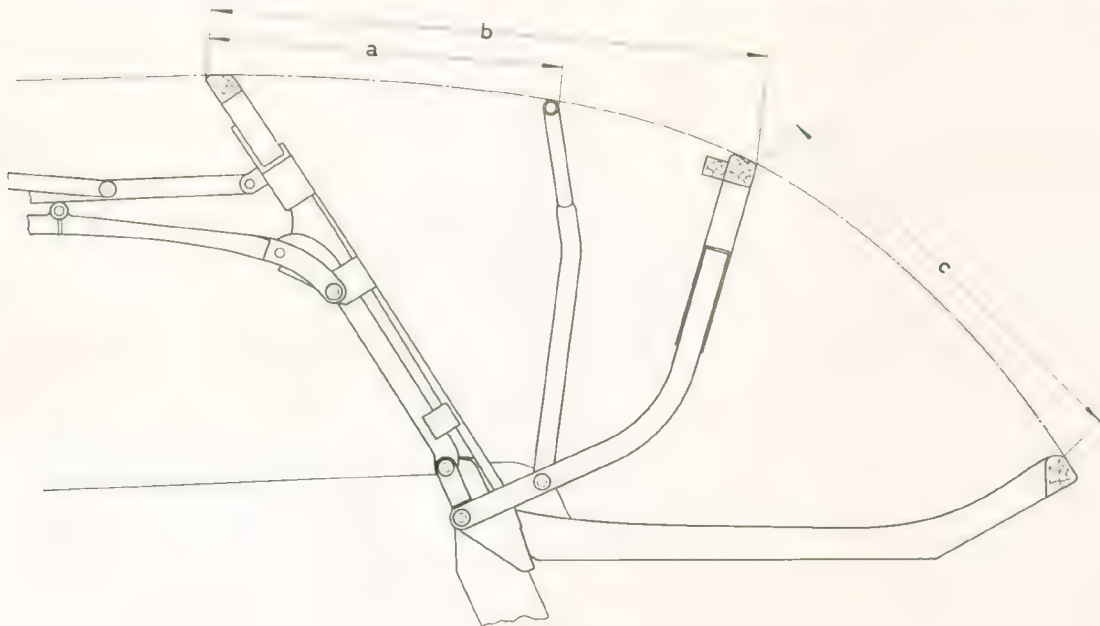
- 15 - Stick a patch of artificial leather to the underside of each of the two main bow corners and nail into position. These leather patches protect the head lining material from water.



- 16 - To establish a better matching of the front parts of the rear support with the body two small leather strips should be nailed to the left and right of the rear support.



- 17 - Lock the top frame by means of the locking devices. Adjust number 2 bow and rear bow to the dimensions given.



a = 350 mm (13.77")  
b = 610 mm (24.01")  
c = 455 mm (17.89")

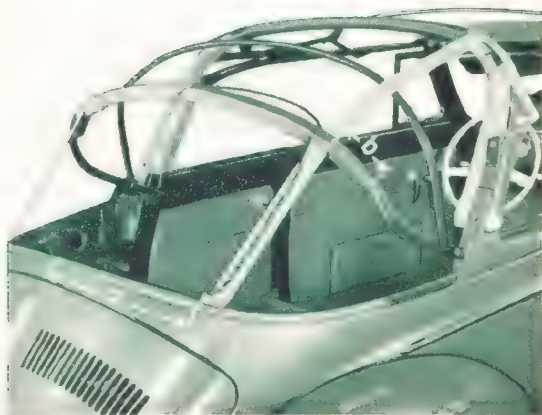
**Important!**

These dimensions should be closely adhered to as proper fitting of the headlining and folding of the top depend on them.

- 18 - Nail straps on the left and right under slight tension to the rear support, rear and main bow, observing the dimensions given. Sew cable for interior light to the right-hand lower strap and pull it through the hole in the rear bow.

The two rear bow straps are to be nailed to the sides as otherwise during installation the ends of the garnish moulding on the top material will lie too high and will stick out.





a = 390 mm (15.35") (center of rear support)  
 b = 120 mm (4.72")  
 c = 250 mm (9.84")

19 - Attach straps on left and right to number 2 bow by means of loops made of the same material. Fasten loops by sewing them into position.

2 - Pull up headlining at each strap until the seam of the cover touches the lower side of the main bow. Stick strap into place and nail it to the top side of the main bow. Cut off protruding cloth strips.

3 - Attach headlining strap at the rear bow in the same way as described above.

4 - Nail strap to the back of the rear support. Cut openings for the straps on the left and right.

5 - Nail headlining under even tension into the groove provided at the upper side of the header nose. Cut off protruding strips of cloth.

6 - Tack headlining on left and right to the inside of the wooden fillers.

7 - Coat number 2 bow with adhesive. Pull up strap as far as the seam and stick around the bow. Cut off protruding strips of cloth.

### Putting headlining into position

The headlining is supplied as a spare part ready for installation. It is provided with straps for fastening at the bows.

In order to obtain a proper fit of the headlining it should be fastened to the individual bows in the following succession with the top closed:

a = Main bow  
 b = Rear bow  
 c = Rear support  
 d = Header nose  
 e = Wooden fillers  
 f = No. 2 bow  
 g = No. 1 bow

Proceed as follows:

1 - Coat front and upper side of main bow with adhesive.



8 - Stick the appropriate strap to number 1 bow and sew it up at the outer edges. It should be observed that the headlining at the sides hangs about 10 mm below the two frame members.

After this work has been carried out check for wrinkles in the headlining and see that the seams of the straps are straight. If necessary adjust the bows.

- 9 - Nail two 4 mm thick pieces of cord to the left and right of the main bow in line with the headlining seams at the side, wrap once around number 2 bow and under tension nail taut to the side of the rear bow.

- 10 - Nail a piece of headlining material to each of the rounded parts on the left and right of the main bow.



- 11 - Sew the side seams of the headlining under tension to the cord.



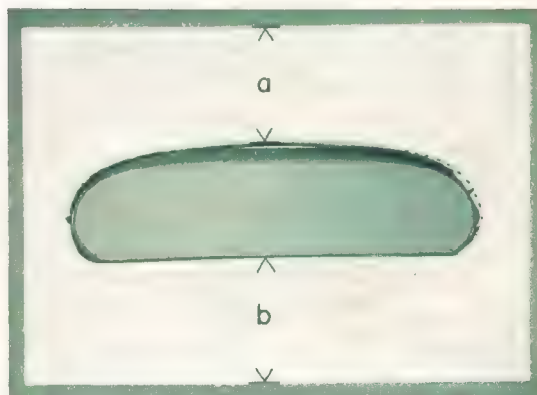
Check from inside whether the side seams of the top are straight. If wrinkles are apparent it is absolutely necessary to re-tighten the headlining.

- 12 - Reposition the lamp socket in the holes provided at the rear bow. Pull the interior light cable through the hole in the lamp socket and through an opening cut into the headlining.

### Installation of rear view window frame

When the frame for the rear view window is installed the top must be in a closed position.

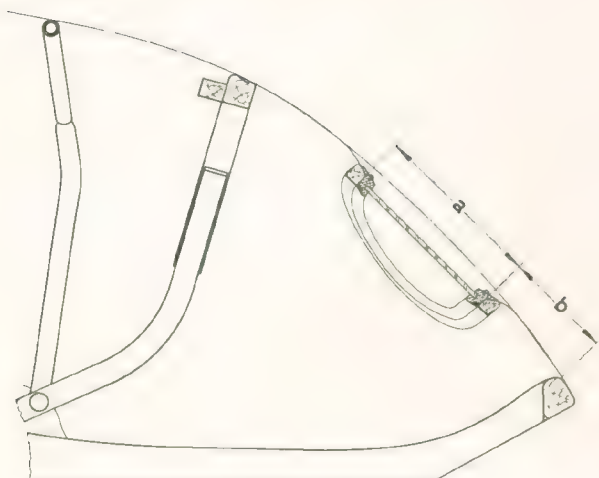
- 1 - Stick a piece of muslin (650 × 850 mm) into the wooden frame so that it protrudes by about 200 mm at top and bottom.
- 2 - Cut a piece of muslin to the size of the frame allowing it to protrude by about 15 mm (.59") all round on the inside. Stick this protruding border to the inside of the wood frame and nail it into position.



$$a = 250 \text{ mm (9.84")}$$

$$b = 200 \text{ mm (7.87")}$$

- 3 - Mark the center of the rear support, the rear bow and the center of the window frame on the muslin.
- 4 - Then nail muslin with window frame in line with the markings to the rear bow and the rear support, pulling it taut the whole time.



$$a = 192 \pm 2 \text{ mm}$$

$$b = 98 \text{ mm}$$

- 5 - Nail two additional straps under tension to the left and right sides of the rear bow and rear support so that the wooden frame of the rear view window comes to rest on the straps. See that the size of the opening for the window is not decreased.



#### Important!

Check whether the window frame is in a horizontal position and in the center. If necessary adjust.

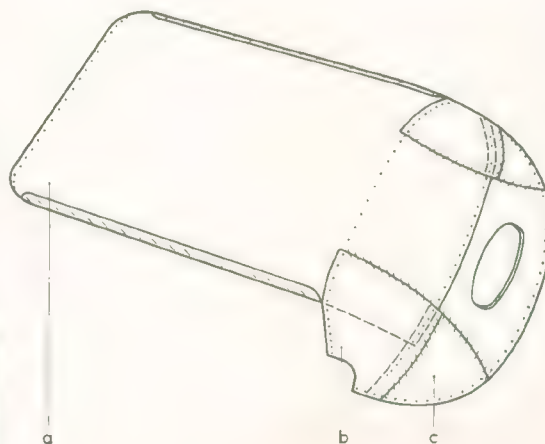
- 6 - Cut off protruding muslin strips.

- 7 - Coat the inside of the wooden frame with adhesive.

- 8 - Cut headlining to size of the wooden frame allowing for a 15 mm/.59" border and stick it on making sure that there are no wrinkles.

#### Installation of linen cover

Before installation of the linen cover cut out 5 pieces of linen cloth to the following dimensions:



$$a = 1370 \times 1700 \text{ mm} / 53.94'' \times 66.93''$$

$$b = 450 \times 650 \text{ mm (twice)} / 17.71'' \times 25.59''$$

$$c = 450 \times 480 \text{ mm (twice)} / 17.71'' \times 18.90''$$

----- = nailed

~~~~~ = stitched

- 1 - Pulling taut, nail side pieces (c) on left and right to rear support and rear bow. Cut off protruding cloth strips.

- 2 - Nail roof piece (a) to rear bow.

- 3 - Tack roof piece to header nose, keeping it free of wrinkles.

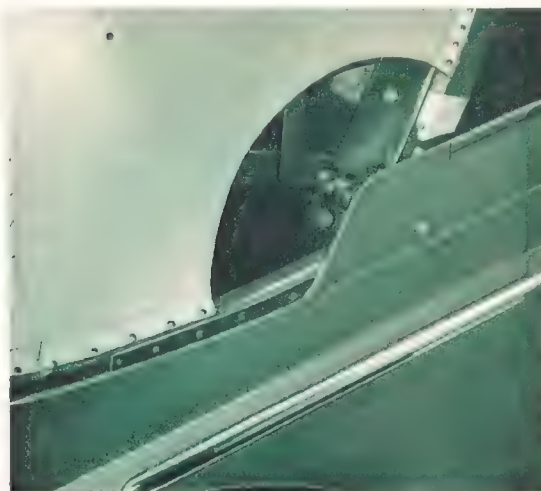


4 - Nail roof piece to main bow. There should be no wrinkles.

5 - Linen hanging over the sides of the roof should be hemmed over up to the roof frame and should later be sewn to the rubber hair mat.

6 - Nail side pieces (b) on left and right to main bow, rear bow and rear support, keeping free of wrinkles.

7 - Cut a semicircle of about 150 mm/5.91" radius into side pieces (b) for main hinges.

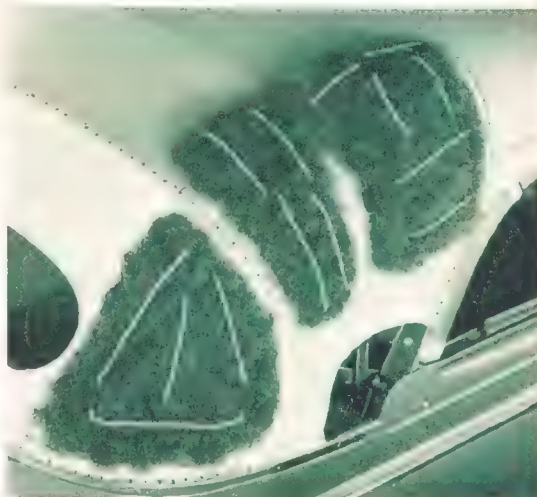


8 - Sew side pieces (c) to rear window frame muslin and side pieces (b) pulling taut. Sew side pieces (b) to roof piece (a) also keeping tightly stretched.



9 - Make loose stitches of approximately 10—15 cm along the rounded sides of the linen cover between main and number 2 bow, between number 2 bow and rear bow and between rear bow and rear support.

10 - Insert padding—horse hair if possible—of even thickness under the stitches between the bows.



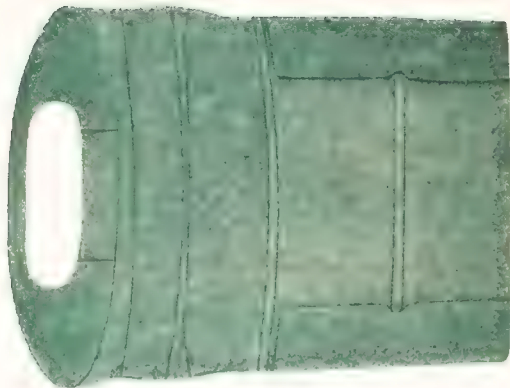
#### Important!

The padding determines the shape and smoothness of the rear of the top. If it is either too thick or too thin in places the top will be uneven.

#### Sewing on rubber hair mat

This mat can be obtained in one piece as a spare part. Before sewing it on, the strip which is positioned between the part for the rear view window and the large part for the roof, and which can be recognized by its particular seating depth, should be cut out. After this, two wedge-shaped pieces should be cut out on the left and right to make the folding back of the top easier. If necessary the outer pressed edges of the rubber mat can be cut off.

On the left in the picture you can see the rubber hair mat as delivered and underneath the underside of the mat cut ready for installation.



1 - Slightly pull out the hair on the cut edges of the rubber hair mats to insure proper matching at the roof edges.

2 - Put both pieces of the rubber hair mats into position.



3 - Pull rubber hair mat at the rear view window from the rear bow toward the rear support and attach it to the linen cover with rough stitches.

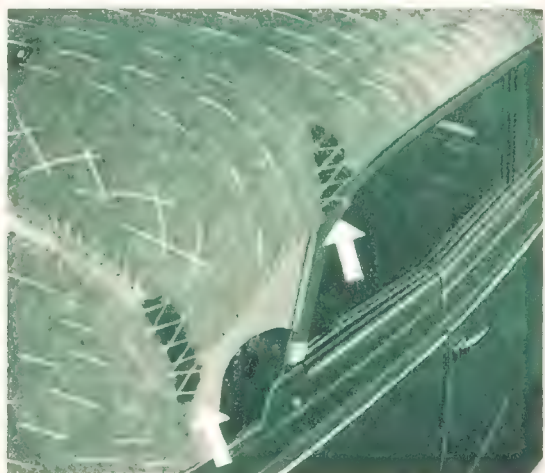
4 - Sew roof part of the rubber hair mat at a short distance from the rear bow to the linen cover by cross stitches, pull it approximately as far as the rear edge of the header nose and sew it with small tight stitches to the linen cover.

5 - Sew rubber hair mat with long stitches to the linen cover so that the seams are at right angles to driving direction allowing for a distance of approximately 100 mm/3.94" between the seams.

6 - Sew the outer edges at the sides with small tight stitches to the border of the linen cover.

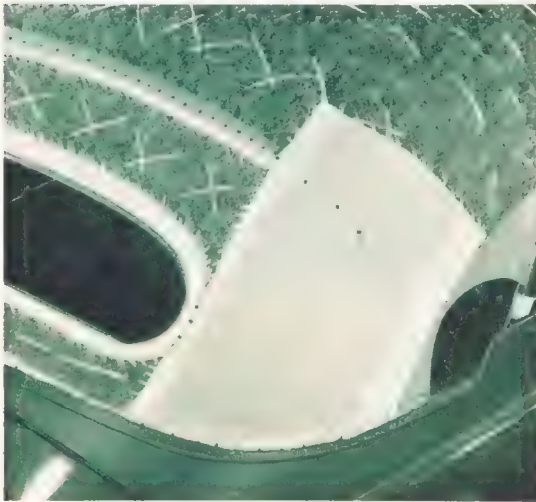


7 - Pad out the wedge-like cuts in the rubber hair mat near the main bow and the cavities on the outer edges between roof mat and rear wall mat to obtain smooth areas. Sew wadding into place with long stitches.





- 8 - Cover the left and right rear corners with a piece of muslin (550 × 400 mm/21.65" × 15.75"), pull tight and sew it with small stitches to the side linen cover and to the rubber hair mat. Nail the muslin to the rear bow and rear support.

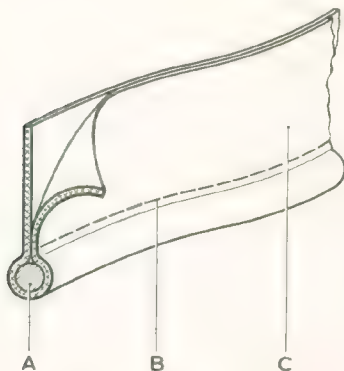


#### Installation of outer cover

For installation of the outer cover the top must be closed.

A linen cover is sewn to both sides under the outer cover. Pull the rubber hair mat through the outer and the linen cover after loosening it at the header nose.

- 1 - Cut a piece of moulding 50 × 1850 mm/1.97" × 72.83" as specified in drawing. The colour of the moulding should be the same as that of the top.



A = Textile cord stiffener 4 mm dia./157"  
B = Seam  
C = Top material

- 2 - Coat rear support with sealing compound. Nail moulding into place - under tension to the sides - so that the beading comes to rest on the nails in the rear support.



- 3 - Loosen linen cover with sewn-on rubber hair mat from the header nose and fold it backward.

#### Important!

Do not loosen the linen cover at the main bow.

- 4 - Place outer cover onto the top.

- 5 - The outer cover is marked at both sides near the main bow by two white lines. First pull the cover to the right side so that the lower





white line touches the lower edge of the wooden main bow.

- 6 - Tack protruding strip on the inside to the right-hand side of the main bow with 4 nails.

- 7 - Fold the rear part of the outer cover forward and nail the linen cover under tension working from the right-hand side as far as the middle, to the wooden main bow.

- 8 - Loosen the outer cover strip on the right-hand side and repeat the same procedure on the left-hand side.

Observe the markings on the outer cover and side tension!

- 9 - Loosen the strip of the outer cover at the left side of the main bow. Apply some talc powder to the rubberized upper side of the outer cover and push rubber hair mat forward as indicated by arrow.



- 10 - Push the folded-over outer cover back and tack strips on the left and right to the main bow.

- 11 - Pull rubber hair mat tight toward the header nose.



- 12 - Pull outer cover back so that the cut in the cover lies exactly on the rear bow.

- 13 - Nail outer cover under side tension to both sides of the main bow with a nail for each side.

#### **Important!**

The seams of the outer cover must be straight.

- 14 - Pull outer cover backward and, stretching taut, nail to the left and right of the rear support.

#### **Note:**

In order to avoid damage to the outer cover both nails should be driven through the seams.

- 15 - Nail outer cover tautly to the rear side rail, pull it from the two seams toward the main hinge. Do not yet fasten the cover to the middle of the rear support.

- 16 - Pull outer cover tight toward the front and nail linen cover under tension to the header nose corners.

- 17 - Nail linen cover with sewn-on rubber hair mat into the recess in the header nose under tension, taking care to avoid wrinkles. Cut off protruding strips.

**Important!**

The linen cover and lining must be a neat fit in the header nose. Otherwise a sharp edge will be apparent on the header nose.

- 18 - Stick and nail a broad sealing strip over the recessed part of the header nose to obtain a smooth area between edge and rounded part.



- 19 - Enlarge the cut in the outer cover at both sides of the rear bow by about 40 mm/1.57" toward the outside. The purpose of this cut is to avoid wrinkles in the outer cover.

- 20 - Cut a groove of about 3 mm/.12" depth into the rear bow for the two side seams of the cover. This is to insure proper seating of the garnish moulding to be nailed on later.



- 21 - Nail outer cover under even tension and without wrinkles to the rear bow. First nail on the lower part and on top of that the upper part to prevent ingress of water through the cut.

- 22 - Coat the corners of the nailed-on cover with gum solution.



- 23 - Nail the cover to the rear support under tension and without wrinkles. Make sure that the beading is evenly spaced from the cover. Cut off protruding strips.

- 24 - Fill the cover at both corners behind the header nose with some horse hair and with two pieces of wadding for each corner (approximately  $150 \times 200 \text{ mm}/5.91" \times 7.87"$ ).



**Important!**

The amount of wadding and horse hair used determines the evenness and shape of the header nose corners. Too much or too little upholstery material will result either in bulges or wrinkles.

- 25 - Open the top by about  $180 \text{ mm}/7.09"$ .  
 26 - Nail the outer cover to the sides of the header nose with three nails for each side. Check for proper tension.  
 27 - Nail the tacked-on cover under tension to the left and right of the main bow so that the cover



touches the headlining and the seam comes to rest on the front outer edge of the main bow. Cut off protruding strips.

- 28 - Tack the cover at the two seams on the left and right with two nails on each side to the header nose ensuring proper tension.

- 29 - Close the top, wind up the windows and check for obstructions when opening the doors.

The door window frames must not come into contact with the cover. The cover should, however, come down as low as possible. Check for side tension of the cover. Insufficient tension will result in noise. Should the cover come into contact with the door window frames — or if there is not enough side tension — the cover must be loosened again at the sides of the header nose and should be adjusted with the top open.

- 30 - Close the top and make small cuts at the sewn-in beading on the left and right in the front.

- 31 - Put the beading on the left and right around the header nose and nail it tautly into position.

- 32 - Nail the cover evenly from the corners of the header nose towards the middle so that it is above  $20 \text{ mm}/.787"$  away from the cloth-covered lower edge of the header nose, avoiding wrinkles.



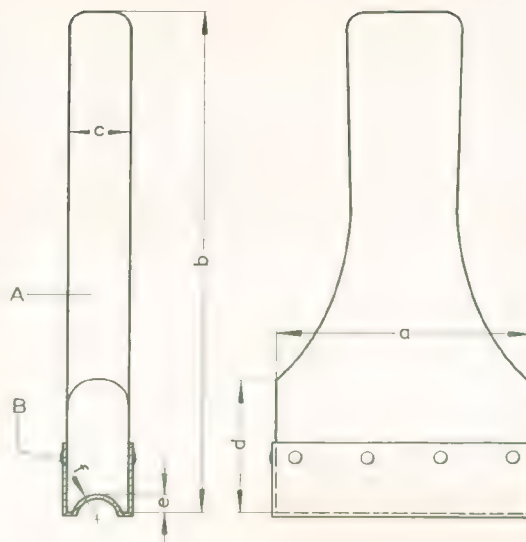
$a = 20 \text{ mm}$



33 - Neatly cut off protruding strips.

34 - Cut opening for rear window into cover. Stick and nail the cover to the rear view window frame.

35 - Check for even tension and absence of wrinkles around the nails. If necessary stretch the cover again and nail it back into place.



A = Installation tool

B = Leather covering (1 mm/.039")

a = 70 mm/2.75"

d = 35 mm/1.37"

b = 140 mm/5.51"

e = 5 mm/.196"

c = 17 mm/.669"

f = 7 mm/.275"

36 - Neatly cut off the protruding strip.

37 - Nail a sealing strip of 8 mm (.314") over each of the rows of nails on the rear support, rear bow and header nose.

38 - Nail garnish mouldings with the aid of the wooden tool into position as shown in drawing and straighten them if necessary.



The garnish moulding on the rear support must be in exact line with the rounded part of the beading.

#### Important!

In order to ensure faultless installation it is absolutely necessary to use the wooden tool shown in the drawing.

39 - Install chromium screws with washers. In order to prevent the screws from rusting they should be painted to match the colour of the top.



40 - Before installation of the assembled rear view window check for proper fit in the window opening without sealing compound. Then apply a thin coat of sealing compound to the nailed area in the wooden frame and install window. In order to prevent the linen piece at the rear view window frame from getting torn during installation owing to the pressure applied from outside an assistant should support the wooden frame from inside the car.

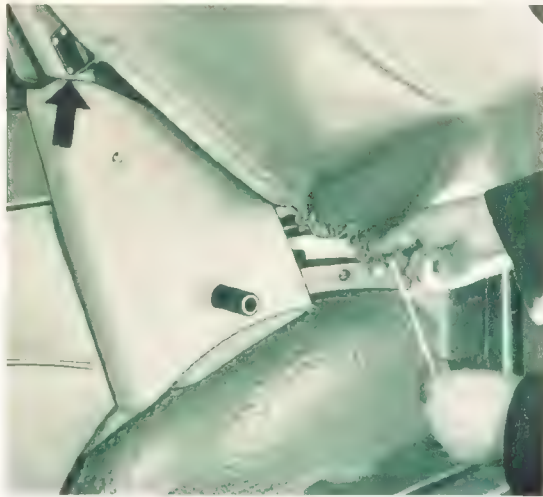
#### Installing headlining

- 1 - Put the headlining securing screws at front left and right sides near the locking mechanisms into the holes provided in both frame side members and tighten them.
- 2 - Fasten the two pieces of wood covered with headlining material for the two boot pillars on the left and right in the holes provided.

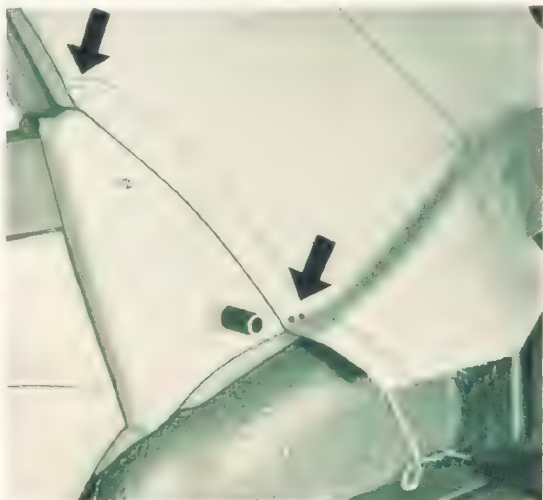


3 - Loosen the cover and stick it to the pieces of wood and to the body underneath the rear side trimmings. Then fasten side trimmings.

4 - Nail rubber band to the left and right wooden fillers and stretch it.



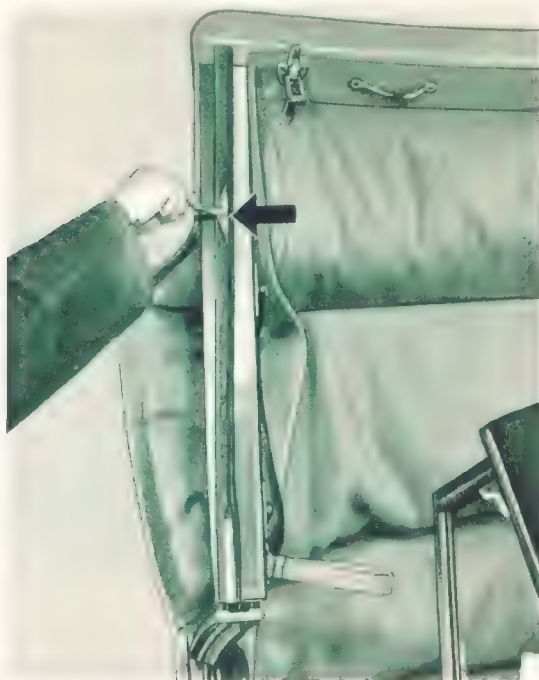
5 - Nail the headlining with one nail to each of the wooden fillers (the heads of the nails should be covered with cloth). Then nail the headlining with the tightened rubber band to the underside of the wooden pieces.



6 - Fasten the interior roof light on the lamp socket and connect it up.

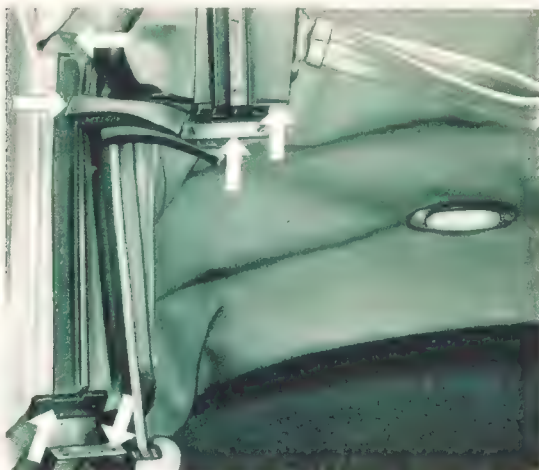
7 - Fix carpets in luggage compartment and on wheel housings by gluing them on.

- 8 - Screw assist straps on left and right with brackets into the holes provided in the roof side members.
- 9 - Screw three rubber seals together with the appropriate rails to each of the two roof side members on the left and right so that the windows, when closed, come to rest on the rubber lips on the inside.



The rails should be under the rubber lip. In the case of a new roof supporting frame the holes must be drilled according to the holes in the rails.

- 10 - Screw 6 chrome-plated cover plates to the main

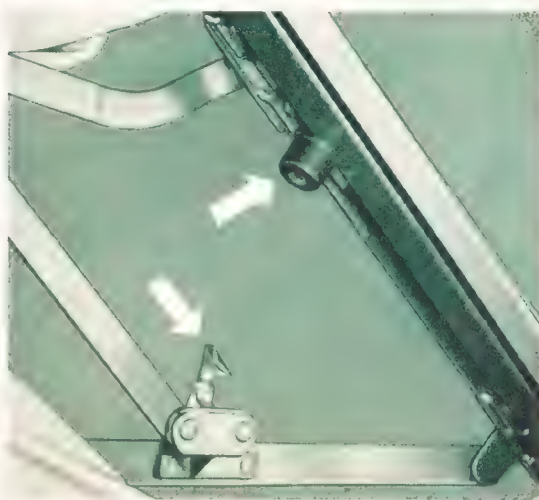


bow and roof frame at both sides. Place a piece of sealing rubber under each of the cover plates at both ends of the main bow. With new top linkage the holes must first be drilled in some cases.

**Note:**

With a new top cover the top linkage tends to arch resulting in excessive clearance between window and roof frame. Put something under the cover plates of the front hinges on the roof frame near the assist straps and the linkage will come lower down. If the linkage comes down too low (older top covers) it can be raised by grinding off the cover plates.

- 11 - Screw snap fasteners and grommets into the holes provided.



After the installation has been completed check for proper opening and closing of the top.

- 12 - Install seats.

Clean the outer cover with a soft brush and rinse it with clean water. Allow the top to dry in the closed position.

With a new top a certain amount of tension is normal. It is therefore not necessary to try to decrease the tension in any way. After the vehicle has been used for some time the cover will expand to a certain degree thus allowing easy closing of the top.



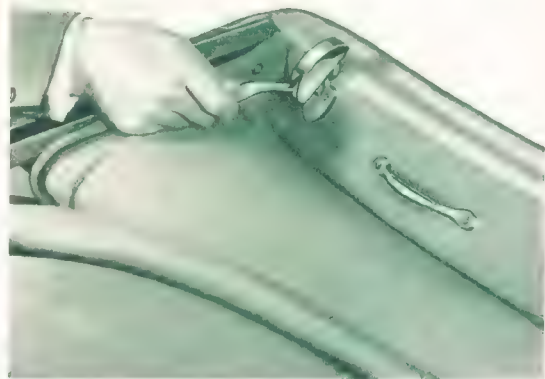
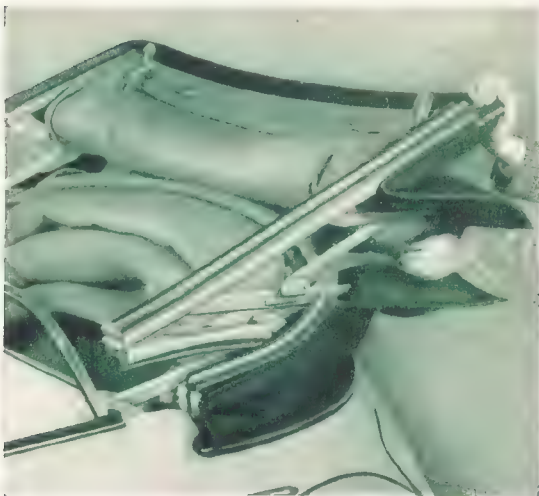
## Lowering and Raising the Top

### To Lower the Top

- 1 - Pull the two clamps above the windshield downward to unfasten the top.
- 2 - Raise the header slightly and fold back the top.
- 3 - Withdraw top cover from the linkages on both sides.
- 5 - Press down the top until the spring-loaded catches (one on each side) engage in the slots cut in the side rails.
- 6 - Place the caps of the top clamps on the guides and press down the levers.



- 4 - Push the top lining inward so that the linkages are free.

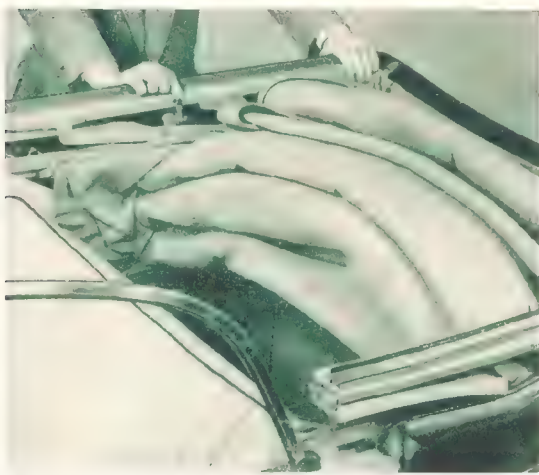


- 7 - Install the top boot from the rear and secure it with the snap fasteners. The top cover should be perfectly concealed by the boot, paying particular attention to the bottom part of the boot. The ornamental strip at the top cover rear edge should be visible.



### To Raise the Top

- 1 - Unfasten the press buttons of the top boot and remove the boot toward the rear. The boot is best stored in one of the two luggage compartments.
- 2 - Turn back the clamp levers.
- 3 - Press down the top and disengage the catches.



- 4 - Raise the top.
- 5 - Pull down the top until the header guides have entered the slots of the brackets.
- 6 - Place the clamp caps over the noses of the brackets and clip the levers over.



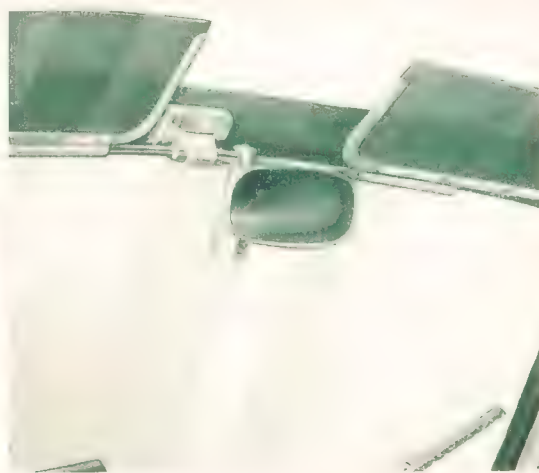
### Rear View Mirror

The rear view mirror of the Convertible is adjustable to insure a perfect view no matter if the top is lowered or raised. With the top in the raised position,



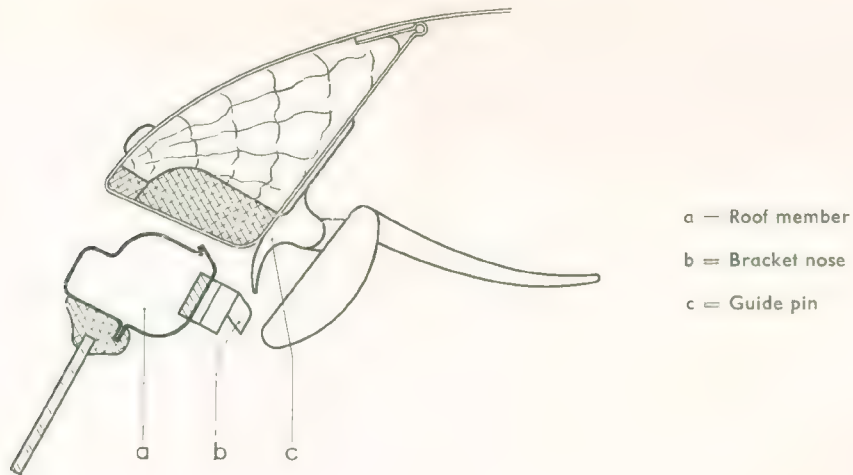
turn the mirror holding rod down by 180° and push the mirror toward the windshield until the stop can be felt.

By turning the mirror to the vertical position, an additional adjustment is obtained to suit individual requirements.

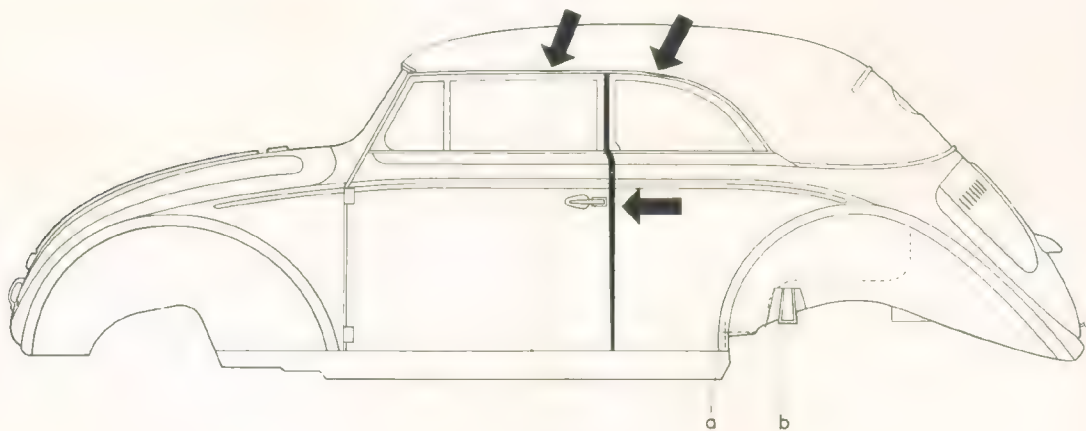


## Adjusting the Convertible Top

A - The guide pins of the two roof locking mechanisms hit against the lower part of the bracket noses.



If a guide pin on closing the top hits against the bracket nose check whether both frame side members on left and right are resting on the window frames with the top in the closed position and whether there is a wedge-shaped opening between the doors and the rear side panels which is widening out toward the top.

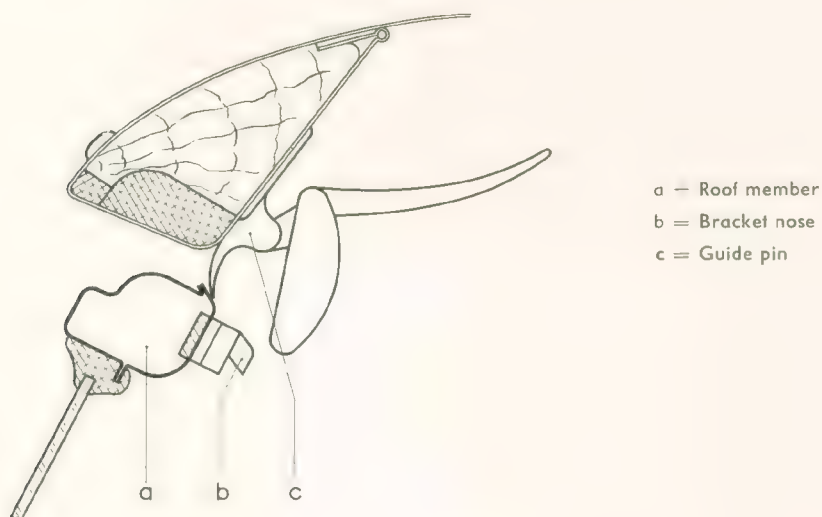


If the two frame side members are resting on the window frames it would appear that the roof support rods have got bent during opening. Close the top, and, by means of a lever, bend the side members up so far that the guide pins will slip into the bracket noses.



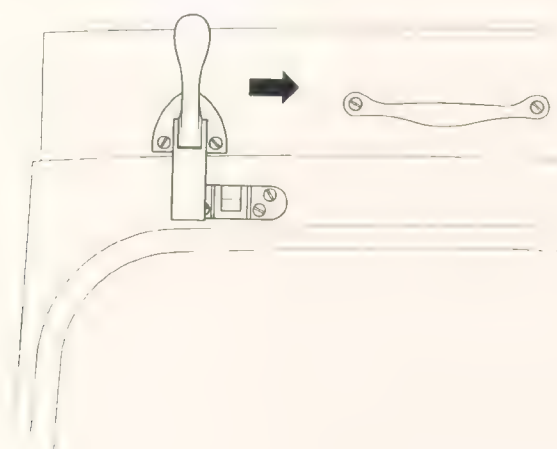
If a wedge-like opening is apparent between the doors and rear side panels remove the mounting screws at the points a and b in the body. Place a hard rubber plate of 3 mm thickness under the body supports on the left and right. Tighten the body screws. Should the gaps not be of normal width yet use thicker rubber plates.

B - Guide pins of both locking mechanisms hit against the windshield cross member.



If the guide pins of the two locking mechanisms hit against the windshield cross member put small pieces of leather under the upper parts of the mechanisms until the guide pins will engage. (See arrow.)

C - Guide pins of the two locking mechanisms come to rest beside the lower parts.



If the guide pins come to rest on the left and right beside the lower parts close the top but do not lock it. It should only rest lightly on the cross member of the windshield. Adjust roof linkage if necessary and pull it into position until the guide pins will easily engage.



### Painting with Genuine VW Paints of the Groups LKL, LK and L

#### General

The paint finish of all current production VW models consists of oven-dry Genuine VW Synthetic Resin Undercoats and Finish Coats, the normal drying time being 45 minutes at a temperature of 125° C (257° F).

The advantages of such paint materials lie in their high resistance to weathering, impact, discoloration and to the effects of the common solvents such as fuel, lacquer and enamel thinners, cleaners, etc.

Retaining these properties when performing repair jobs calls for the application of special paint materials as detailed in this section.

#### Paint Materials

The following materials are to be used for refinishing or repair jobs:

- a - air-dry synthetic resin enamels of the group LKL (referred to in the text as "LKL Paints").
- b - oven-dry synthetic resin enamel of the group LK (referred to in the text as "LK paints").
- c - nitro-combination lacquers of the group L (referred to in the text as "L Paints").

- 1 - By using LKL and LK paints, the same effect and quality of the finish is obtained as with the factory-applied oven-dry enamels.

The only variation from the original painting is the air-drying time of LKL paints ("dust dry" after 3—4 hours, depending on the atmospheric temperature, and "tack free" after about 12 hours). When using a source of heat, which should not heat up the refinished area in excess of 80—85° C (176—185° F), the paint is "tack dry" within 45 or 60 minutes.

The LK enamels (often referred to as 80° C/176° F enamels) can be polished (to remove nibs caused by inclusion of dust) or resprayed (to correct flaws) immediately after the body has cooled down, as the finish is then completely hard.

- 2 - A perfect finish repair job calls for a careful matching of the repair material with the exact shade of color of the original finish on the body.

#### Note:

There will always be a slight variation in the color shade of the original finish, necessitating the repair material to be tinted for an exact matching.

As the practice of adding mixing enamels to the refinish paints in volumes of 100 grams has proved not to be the ideal solution, these enamels have been discarded in favour of Genuine VW Mixing Paints of the groups LKL and L, each group comprising 12 tinting colors. Thus matching is easier and more accurate.

The LK enamels are mixed with the tinting colours of the group LKL for matching purposes.

- 3 - To facilitate refinish or repair jobs and to simplify paint stock keeping, the undercoat materials have been standardized.

Undercoat materials of the group LKL have been abolished in favour of those of the group L (nitro paints). These Genuine VW Combination Lacquers have been developed to offer the same high quality, while facilitating and speeding up paint jobs.

- 4 - As to the choice between the two groups of material for the finish coat, preference should be given to LK or LKL paints (synthetic resin enamels) in order to obtain a finish similar to that originally applied to the body.

The group L comprises nitro-combination lacquers that, although drying faster than enamel and being easy to polish, have completely different characteristics, which make them vary from the color shade and gloss of the original finish. The painted spot can be distinguished from its surrounding area even after a short time, calling for very frequent repolishing. It is therefore strongly recommended to use paint of the group L for quick spotting jobs in obscure places on the vehicle only, and no attempt should be made to match the color in a prominent spot. On no account should lacquers of the group L be used for touch-up jobs at spots which come into contact with the sliding roof cover made of PVC, as this would have a softening effect on both paint and roof cover.

### Fundamental Notes

- 1 - Absolute cleanliness in spray booths and ovens is essential to a satisfactory application of the paint. Another important point is to keep the booth free from drafts or excessive movement of the air and to provide for an effective exhaust. The floor is to be kept sufficiently wet and the temperature inside the booth should be within 18° and 25° C (64° and 77° F). It is impossible to get a fine finish without the use of a good oil and water extractor in the compressed air line and a precision air pressure control. In addition to the usual painting equipment not yet mentioned, a mobile bank of infra red lamps should be available. The air compressor should have a capacity of 400 liters per minute at 6 kg/cm<sup>2</sup> (12 cu. ft. at 85 lbs./sq. in.).

- 2 - Nitro paint spray tends to explode on contact with synthetic resin spray. As an alternate spraying of both paint materials cannot be avoided in one booth, it is essential to clean the booths, including the paint spray filter systems and the exhaust passages, at least once a week. Any heavy accumulation of paint spray **must** be avoided, unless the aforementioned equipment parts are kept moist with water (depending on filtering and exhaust systems in use).

- 3 - LKL enamel should not be hand-rubbed until after it has thoroughly hardened. This will be after 1—1.5 hours at 70—75° C (158—167° F) in an oven and a subsequent air-drying time of 12—24 hours, or after 96 hours when air drying only.

Oven-dry synthetic resin enamels of the group LK have the advantage of providing complete hardness of the film after 50 or 60 minutes of "baking" at a temperature of 80° or 90° C (176° or 194° F). The minimum baking temperature of 80°—90° C (176°—194° F) should be given at all points of the body (also at the sill panel). Oven-dry enamels will not dry in the air after the car has left the oven. If not sufficiently "baked", the film will remain soft or even tacky. However, the temperature at roof level should not exceed 90° (194° F), as this would cause damage to, and accelerate the aging of, rubber and plastic parts, adhesives, and sealing compounds. It is advisable to remove accessories of the materials mentioned. The sun vizor should always be removed.

In the case of a poor paint job with LKL enamel due to dust having settled in the finish, no attempt should be made to polish off the nibs immediately. If there is no time available to wait until the finish has thoroughly hardened, another coat is applied after wet-sanding the repaired area. This coat should be as thin as possible.

- 4 - To improve the scratch-resistance of the LKL finish, it is recommended to wax the body with preservative L 190 immediately after the specified air-drying or oven-drying time. Apply the preservative with soft cotton and let it dry for 20 minutes. Then rub down with a soft cotton until iridescent colors can no longer be seen when standing at an angle to the polished area.



- 5 - A good paint job mainly depends on the cleaning and the preparation of the body or parts of the body for refinish or repair jobs. Water should be liberally applied while cleaning.

To avoid water spots, the water should not be dried off in an oven, but should be removed with a chamois skin, followed by cleaning all cracks and crevices with compressed air.

- 6 - A complete refinishing of the body should be done with the help of a pressure tank having a capacity of 5—8 liters of paint (5—8 quarts). The fluid (paint) pressure is 1.2—1.4 kg/cm<sup>2</sup> (17—20 lbs./sq. in.) for both undercoat and finish coat materials. This allows the spraying to be done in the shortest possible time, which is a decisive factor in obtaining a flawless finish.

a - The paint can be sprayed without interruptions, as a replenishing of spray gun cups is rendered unnecessary.

b - The flow of the paint to the spray gun is more constant, assuring a better atomizing and a uniform paint film.

c - The spray gun is easier to handle because of the absence of a cup, making for a speedy and uniform application of the paint.

d - The pressure tank allows two painters to refinish the body without calling for additional facilities, as the pressure tank connections provide for feeding two guns.

- 7 - To obtain a good matching, it is of paramount importance to thoroughly stir both the refinish and the tinting paints to dissolve even the faintest trace of solid matter that may have settled.

The paints must be thinned to the required consistency or viscosity for spraying with the appropriate thinner only.

### Paint Repair Jobs

- 1 - Spot painting with LKL and LK enamels is so difficult that painting of the entire panel, roof, hood, or fender and "masking" the surrounding parts with tape and paper is recommended.

Such practice avoids more or less detectable spots that do not harmonize with their surrounding areas. It should be made clear to the customer that the somewhat greater demand for paint and masking materials will be more than compensated by saving polishing times and polishes.

If ovens are not available, the drying time of the enamels can be reduced substantially by using mobile banks of infra-red heating lamps. It should be noted, however, that the banks are positioned at a distance from the body which will prevent the painted surface from being heated up in excess of 80—85 °C (176—185 °F).

- 2 - Qualified painters can perform spot painting with LKL and LK enamels so skillfully that the newly painted spot cannot be distinguished from its surrounding area. Spot painting is preferably applied on such large areas as the roof. Here is the procedure: Featheredge the old finish around the spot with No. 360 sandpaper. When spots have been sanded down to the metal, apply Genuine VW Primer (reddish-brown) and then, after an air-drying time of 1—2 hours, Genuine VW Surfacer (grey). Should the repair call for the use of glazing putty (also called "filler"), apply Genuine VW Putty (greyish-green) over the sprayed-on primer. After the subsequently sprayed-on surfacer has dried for 2 hours, wet-sand the spot, extending over the edge by the width of a hand, with No. 600 sandpaper and soapy water. Wipe dry and spray the spot with the matched finish enamel, taking care that the outer circumference of the featheredge remains visible over a width of 1 in. Immediately afterwards, mist coat the edges of the spot with 1 part enamel thinned by 3 parts thinner. After the paint has dried, infra-red lamps **must** be used for spot painting, the newly painted spot and its surrounding area should be rubbed with Genuine VW Paste Polish L 180 and then polished with Genuine VW Liquid Polish L 170.

- 3 - The spot painting method described under "2" is **not** applicable to metallic lustre finishes. Repair jobs should be carried out as recommended under "1".

Due to their perlescent effect, metallic finishes are more difficult to repair than those of normal paints. If the spray coats are not applied at the proper wetness, the color will not match. Even the slightest variations in the thickness of the finish coat or in the color shade of the undercoat will result in a mismatch. To obtain the exact color shade of the original finish calls for all the skill of a well qualified painter. Metallic repair paint is tinted with Genuine VW Combination Lacquer LM 90 or Enamel LKM 90 and sprayed on a test panel coated with Genuine VW Surfacer L 141, grey, to obtain a faithful reproduction of the original finish. The proper spraying viscosity for metallic paints is 21—22 seconds in the 4 mm DIN efflux viscosity cup.

The spray coats should be light wet to prevent "floating" (coming to the surface) of the perlescent particles. To obtain light-wet spray coats, the gun should be held at a greater distance from the surface to be painted. Spraying is completed with a light mist coat.

## Finishing and Refinishing Jobs

### A - Finishing a primed body or primed body parts (Spare Parts):

- 1 - Sand the primer with No. 360 sandpaper, taking care not to sand down to the metal.

- 2 - Spray Genuine VW Surfacer L 141, grey, over the primer:

|                       |                                                                     |
|-----------------------|---------------------------------------------------------------------|
| Thinning:             | Genuine VW Thinner L 160.                                           |
| Viscosity:            | about 22 seconds at 20° C (68° F) in 4 mm DIN efflux viscosity cup. |
| Air pressure:         | 4—5 kg/cm <sup>2</sup> (57—71 lbs./sq. in.).                        |
| Fluid-control nozzle: | 1.0 mm.                                                             |
| Application:          | 3 successive coverings.                                             |
| Air-drying time:      | 1—2 hours.                                                          |
| Oven-drying time:     | 30—40 minutes at 40—60° C (104—140° F).                             |

- 3 - When dry, wet-sand this surfacer with No. 400 sandpaper. After all traces of water have evaporated and the sanding residue has been removed, the finish paint of the groups LKL or L is applied.

- a - When using enamels of the group LKL, the following should be observed:

|                       |                                                                              |
|-----------------------|------------------------------------------------------------------------------|
| Thinning:             | Genuine VW Thinner LKL 160.                                                  |
| Viscosity:            | about 20—22 seconds at 20° C (68° F) in 4 mm DIN efflux viscosity cup.       |
| Air pressure:         | about 5 kg/cm <sup>2</sup> (71 lbs./sq. in.).                                |
| Fluid-control nozzle: | 1.0 mm.                                                                      |
| Application:          | 2 or 3 successive coverings (any further covering will result in wrinkling). |
| Air-drying time:      | 10—12 hours.                                                                 |
| Oven-drying time:     | 1—2 hours at 60—70° C (140—167° F).                                          |

- b - When using lacquers of the group LK, the following should be observed:

|                       |                                                                        |
|-----------------------|------------------------------------------------------------------------|
| Thinning:             | Genuine VW Thinner LKL 161.                                            |
| Viscosity:            | about 20—22 seconds at 20° C (68° F) in 4 mm DIN efflux viscosity cup. |
| Air-pressure:         | about 5 kg/cm <sup>2</sup> (71 lbs./sq. in.).                          |
| Fluid-control nozzle: | 1 mm.                                                                  |
| Application:          | 2 or 3 successive coverings.                                           |
| Oven-drying time:     | 50—60 min. at 80°—90° C (176°—194° F).                                 |

c - When using lacquers of the group L, the following should be observed:

|                       |                                                                     |
|-----------------------|---------------------------------------------------------------------|
| Thinning:             | Genuine VW Thinner L 160.                                           |
| Viscosity:            | about 22 seconds at 20° C (68° F) in 4 mm DIN efflux viscosity cup. |
| Air pressure:         | 4—5 kg/cm <sup>2</sup> (57—71 lbs./sq. in.).                        |
| Fluid-control nozzle: | 1.0 mm.                                                             |
| Application:          | 3—4 successive coverings.                                           |

After the finish coat has thoroughly hardened, rub the entire surface with Paste Polish L 180 and finally with Liquid Polish L 170.

**Note:**

If bare metal is exposed after having sanded the primer, apply Genuine VW Primer, reddish-brown, to the bare spots by following the instructions given under "a" and "b", but using the same thinner as for the surfacer.

B - Painting new finish coat over old finish.

**Note:**

This can only be done, if the old finish is free from damage such as hairlines, checking, scaling, blistering or any indication of rust spreading underneath the paint film.

- 1 - Carefully examine condition of old finish. Loose paint must be removed by scraping and sanding.
- 2 - To remove all wax and grease, the complete body should be carefully cleaned with benzine and sanded with No. 360 or 400 sandpaper until shiny spots on the old finish can no longer be seen.
- 3 - If, after cleaning and sanding, no bare metal is exposed, the finish coat can be applied as detailed under A, point 3, but care should be taken that the surface is completely dry. Small spots of bare metal (up to 2" in dia.) should be sprayed with Genuine VW Primer L 140, and if larger areas of bare metal are concerned, additionally with Genuine VW Surfacer L 141.

To obtain a uniform gloss, it is good practice to spray a thin coat of Genuine VW Surfacer L 141, having a viscosity of 18—20 minutes in the 4 mm DIN efflux viscosity cup, over the complete body. Then dry-sand the dried surfacer lightly with No. 360a sandpaper.

C - Complete refinishing (removing old paint).

- 1 - Remove old paint by means of a caustic solution. Thoroughly remove all traces of paint, caustic, rust, and water.
- 2 - The body is refinished by applying

Genuine VW Primer.  
Genuine VW Surfacer.  
Genuine VW Lacquer or Enamel.

To carry out these jobs, refer to the data given under A.

If the application of putty is found necessary, this should be done in a number of thin layers, allowing each layer to dry for 20—30 minutes to insure a thorough hardening.



## List of Materials

In addition to the chapter "Fundamental Notes" the following should be observed:

To reduce the paints to the required spraying viscosity, which is particularly important in obtaining a satisfactory repair with enamels of the group LKL and LK, a 4 mm DIN efflux viscosity cup and a stop-watch are required. All materials required for refinishing and repair jobs are obtainable from the Spare Parts Department of the Volkswagenwerk.

Available are:

### a - Undercoat materials.

Genuine VW Primer L 140, reddish-brown.

Genuine VW Surfacer L 141, grey.

Genuine VW Combination Putty L 142, greyish-green.

Genuine VW Thinner L 160.

### b - Finish coat materials.

- 1 - Genuine VW Synthetic Resin Enamels of the group LKL in all colors of finishes on Sedans, Convertible, Coupé, and Transporter models.

Following are the corresponding tinting enamels, which are not delivered automatically with the finish enamels, but should be ordered separately. They are delivered in 1-kg tins.

|               |        |             |        |
|---------------|--------|-------------|--------|
| white         | LKM 80 | yellow      | LKM 60 |
| black         | LKM 40 | fire-red    | LKM 50 |
| ocher         | LKM 61 | ruby        | LKM 51 |
| reddish-brown | LKM 70 | maroon      | LKM 52 |
| green         | LKM 10 | dark green  | LKM 11 |
| aluminium     | LKM 90 | medium blue | LKM 30 |

Genuine VW Thinner LKL 161 is used for reducing LKL paints for spraying.

- 2 - Genuine VW Synthetic Resin Enamels in all colors of Factory applied finishes on VW Sedans, Convertibles and Coupés as mentioned in the Circular, Spare Parts Service No. 10 of 25th March 1958.

The LKM tinting colors mentioned under "1" are used for matching purposes. Genuine VW Thinner LKL 161 is used to reduce the paint for spraying.

- 3 - Genuine VW Combination Lacquers of the group L in all colors of finishes on Sedan, Convertible, Coupé, and Transporter models.

Following are the corresponding tinting enamels, which are not delivered automatically with the finish enamels, but should be ordered separately. They are delivered in 1-kg tins.

|               |       |             |       |
|---------------|-------|-------------|-------|
| white         | LM 80 | yellow      | LM 60 |
| black         | LM 40 | fire-red    | LM 50 |
| ocher         | LM 61 | ruby        | LM 51 |
| reddish-brown | LM 70 | maroon      | LM 52 |
| green         | LM 10 | dark green  | LM 11 |
| aluminium     | LM 90 | medium blue | LM 30 |

Genuine VW Thinner 160 is used for reducing L paints for spraying.

### c - Polishes and Preservatives.

Genuine VW Liquid Polish L 170.

Genuine VW Paste Polish L 180.

Genuine VW Preservative L 190.

## Note:

The Liquid Polish L 170 and the Preservative L 190 are also available in 1/2-kg tins, which are designated L 170.5 and L 190.5.



## Spot-Welding Compound and Paint

### A - Spot-Welding Paste

To obtain water-proof seams, the overlapping edges are to be coated with sealing compound which is resistant to welding.

|                                                                           |                                                   |
|---------------------------------------------------------------------------|---------------------------------------------------|
| Manufacturer: Bonaval-Werk, Bonn am Rhein<br>Brühler Straße 2—20, Germany | Designation: Spot-Welding Compound 59852 or 60506 |
| Teroson-Werke G.m.b.H., Heidelberg,<br>Hans-Bunte-Straße 4, Germany       | Spot-Welding Compound 2257                        |

These products can be obtained directly from the manufacturers.

The compound is applied prior to welding and should not be allowed to flow off, either during or after the welding process. It provides a corrosion preventive and sealing film along the welds which is not affected either by degreasing agents or the paints applied to the body.

Sealing compound that bursts into flame during welding should cease to burn immediately on removal of heat imposed on it by the spot welder.

Spot-welding paste should only be used at points where water-proof seams are required and where a subsequent application of sealing compound is difficult or even impossible.

### B - Spot-Welding Paint

Spot-welding paint is used as a protection against corrosion on hollow parts which make it impossible for paint to be applied after spot-welding due to inaccessibility.

|                                                                                   |                                      |
|-----------------------------------------------------------------------------------|--------------------------------------|
| Manufacturer: Teroson-Werke G.m.b.H., Heidelberg,<br>Hans-Bunte-Straße 4, Germany | Designation: Spot-Welding Paint 2273 |
|-----------------------------------------------------------------------------------|--------------------------------------|

The paint is applied by either a brush or a spraying gun prior to spot-welding.

### General Hints

The spot-welding operation itself is not facilitated by the use of the aforementioned products. In fact it is necessary to adjust the current for fusing the metals to a higher value, depending on the thickness of the material applied.

Any surplus of the applied compound or paint should be removed whenever the exterior of the spot-welded part requires a perfect paint finish. Neither spot-welding paint nor compound can be used as primer for an exterior paint finish.

## Care of the body

### Care and Cleaning of Artificial Leather Covers manufactured on PVC Basis

Artificial leather covers are provided with a very efficient dust-repellent surface. No special preservatives are needed. These only bind dust and dirt and are liable to soil the clothing of the passengers. They also rob the surface of its natural beauty and may even have an adverse effect on the durability of the material.

The following may be used for removing ordinary dirt:

- a - soft water (rain water or hard water which has been softened);
- b - soap suds free of alkaline (soft water with soap flakes);
- c - soap suds, made of soft water and a commercial detergent.

A soft brush will facilitate removal of dirt from scarred surfaces.

Always remove dirt of all kinds as soon as you notice it. Cleaning agents especially suited for removing certain stains can be found on the following pages. Be careful not to pour benzine, spirit, or thinners onto the area to be cleaned but rub it on with a moist rag in order to prevent it from penetrating into the seams or upholstery. It is advisable not to allow the liquid used for cleaning work on the surface for any length of time as the transparent, dirt-repellent protective film of the artificial leather might suffer.

After **each** cleaning of the artificial leather it should be rubbed dry with a soft rag, especially at the seams.

| Stains                                | Removal of                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                             |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                       | new stains                                                                                                                                                                                                                                                                                                                                                                                                         | older stains                                                                                                                                                                                                                                                |
| Oil or grease                         | Remove with dry, soft cloth, turning this several times. Do not make the stain larger by rubbing. Any discoloration on the surface can be dabbed off with a rag moistened with benzine. Rub dry with a clean, soft cloth                                                                                                                                                                                           | Moisten a clean, soft cloth with benzine or spirit, rub over carefully and then rub dry. Turn the cloth several times in order not to spread the stain over a wider area                                                                                    |
| Shoe polish                           | The same applies as described under oil or grease<br>Besides benzine or spirit turpentine may also be used                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                             |
| Artificial resin, nitro or oil paints | Remove with dry, soft cloth in the same manner as with oil and grease. Remove the remaining stains with a rag moistened in water or with a piece of rubber                                                                                                                                                                                                                                                         | Moisten a cloth with artificial resin or nitro thinner, turpentine or benzine, rub over carefully and then rub until dry. For artificial resin stains use artificial resin thinner, for nitro stains nitro thinner and for oil stains turpentine or benzine |
| Blood                                 | Moisten a cloth in cold or, even better, in lukewarm water and dab the stain off. Do not make it worse by rubbing                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                             |
| Rust                                  | Moisten a soft rag with acidified water (1 part of hydrochloric acid to 10 parts of water), dab rust spots carefully but do not spread them by rubbing. The acidified water must not soak into crevices, corners or seams, as otherwise more rust will be created. After this treatment wipe off with a rag, moistened with clean water to remove all traces of acidified water. The rags used should be destroyed |                                                                                                                                                                                                                                                             |

## Cleaning of Roof Covers

### 1 - Cleaning the plastic (PVC) sun roof

- a - Remove normal accumulations of dirt by washing with lukewarm water and a brush.
- b - If warm water fails to effect satisfactory cleaning, use a solution of clean, mild soap suds and then rinse with clear water until all soap has been washed off. Make sure to wash the soap completely off the paintwork of the vehicle, too, and especially from between roof cover and paintwork.
- c - Spots caused by tar, soot, oil, grease or paint which cannot be cleaned off with water or soap solution, should be removed with organic compounds such as, for example, trichloroethylene or gasoline. Do not pour the detergent on the spot to be removed but apply it with a damp cloth. Let it act for a short moment only, then wipe it off and treat the spot first with soap solution and then with clear water. If allowed to remain on the material for too long, organic detergents tend to make the plastic hard or brittle. Be sure that the paintwork and the interior do not come into contact with the detergents.





## 2 - Cleaning of the fabric sun roof

- a - In all events, keep the wet sun roof closed until it is completely dry. With the wet roof opened, the material may become damp-stained and it would then be impossible to remove these stains.
- b - Dusty sun roofs should be brushed with a soft brush only.
- c - Normally, clean the fabric by spraying or rinsing with clear water only.
- d - Spots which cannot be removed with clear water are to be treated with a mild, clean solution of soap suds and with a soft brush. Clean the entire sun roof to avoid spotting and follow up by rinsing with clear water. This method should be used not more than once every six months.
- e - Spots caused by tar, soot, oil, grease, paint etc. which cannot be cleaned off in the above-described manner, should be carefully treated with trichloroethylene or gasoline. Apply the detergent only with a damp cloth. If applied more heavily or even more so if poured on, detergent will damage the structure of the fabric.

The water-proofing of the fabric will lose some of its water repellent qualities when treated with organic compounds and washing solutions. Essentially, however, it depends on the condition of the rubber layer underneath the textile fabric. As a result, the fabric very seldom requires new impregnation. Yet even a new impregnation will not fully restore the original water-repellent characteristics.

## 3 - Re-impregnation of the fabric sun roof

The following water-proofing preparations are recommended:

- a - "Happich-Viktoria-Imprägnierung", made by Gebr. Happich GmbH., Wuppertal-Elberfeld, Germany;
- b - "Imprägnol M-Extra", made by Pfersee GmbH., Augsburg, Germany;
- c - "Primenit VS", made by Farbwerke Höchst, Höchst (Main), Germany, to be used in conjunction with "Ramasit", made by Bad. Anilin- u. Sodafabriken, Ludwigshafen, Germany.

Please comply with the manufacturer's instructions which are supplied with the product.

## 4 - Dyeing of the fabric sun roof

Fabric sun roofs that have become bleached or too light in color through frequent washing or the influence of the weather, may be dyed. Sometimes, however, stripes and paint spots in the fabric may remain more or less visible even after dyeing.

The textile dyes of

Messrs. Artekobin-Gesellschaft Gerhard & Co., Oberntorwall 14, Bielefeld, Germany,

are suitable for dyeing the textile sun roof. The sun roof has to be closed during treatment. Newly dyed sun roofs need not be impregnated again as the dyes already contain an impregnating agent.

## Cleaning the Windshield

Some fluid or pasty preservatives contain silicon for greater efficiency. If such preservatives come into contact with the windshield, the silicon contents will cause streaks and clouding within the range of the wiper blade when it rains, thus impairing visibility and driving safety.

Normal cleaning agents and solvents are not suitable for removing these effects of the silicon from the windshield and we should, therefore, like to recommend the following measures:

- 1 - Use "SIDOL" manufactured by Messrs. Siegel & Co., Cologne, Western Germany. For the indicated purpose it is easiest to apply it as a paste. Rub it over the windshield, let it dry and then wipe it off. Be most careful, however, that "SIDOL" does not come into contact with the paintwork.
- 2 - Instead of using "SIDOL", you may apply a home-made paste consisting of 2 weight-parts of Vienna lime and 3 volume-parts of water. Adding a few drops of liquid ammonia will further improve the cleaning efficiency of the paste but it will also give it a somewhat unpleasant smell. This type of paste must not come into contact with the paintwork, either. It is applied as described under point 1.
- 3 - A third way to remove the above-described streaks or cloudiness is to wipe the windshield with cleaning gasoline and to treat it subsequently with acidulated water. Acidulated water consists of 1 volume-part of muriatic acid and 9 volume-parts of water. Afterward, rinse carefully with clear water.

The wiper blades should be cleaned at the same time. Sometimes, however, new blades have to be fitted to keep the windshield clear afterward.

In this connection we should like to draw your attention to the following points:

- 1 - When using any agents containing silicon, the brushes, sponges, chamois and rags used to clean the paintwork may not be used for the windshield.
- 2 - Whenever the paintwork is to be sprayed with preservatives containing silicon, be sure to cover first windshield and windows with cardboard or other suitable material.

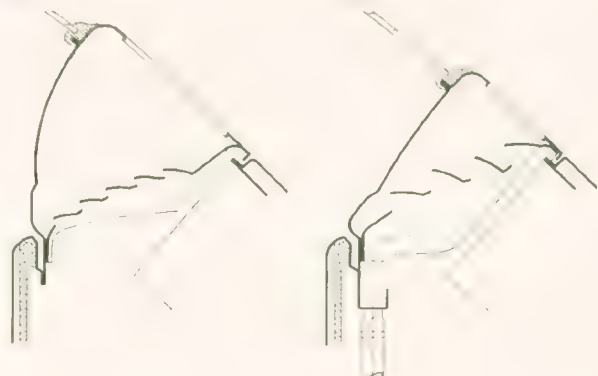
The Genuine VW Preservative L 190 contains silicon.

## Body Modifications (Passenger Cars)

### Cooling Air Intake

From Chassis No. 1 600 440, August 1st, 1957, the cooling air intake below the rear view window is of an improved version, and the engine compartment is better protected against ingress of water. The cover plate below the cooling air slots permits a better entry of cooling air into the engine compartment because of larger openings.

Water entering through the cooling air slots is collected on the cover plate from where it flows towards the sides into a gutter on the engine compartment front panel and runs from here via hoses to the underside of the vehicle. Water entering at the upper gap of the hood beside the solts is collected on deflector plates at both upper corners of the engine compartment opening from where it drains off.



earlier type

new type

These measures reduce possible ingress of water into the engine compartment to a minimum.

Installation of new roofs in vehicles of earlier design, even in connection with the new instrument panel, is not possible. Body parts of previous design will still be available in future.

Complete bodies of earlier design will only be available until stocks have been used up.

## Heating

On December 19th, 1956, Chassis No. 1 385 974, the hot air passage on the VW Sedan and VW Convertible was modified to make the heating system more effective.

The heated air is now guided through a duct enclosed in each of the two body side members (sills) up to the junction of the windshield defroster vents and the outlets at foot level in the front compartment. The ducts, consisting of two halves, are dip-coated for rust protection prior to being spot-welded into the body side members.

The improved heating can be identified externally by the outlets in the front being arranged further towards the rear.

The new body side members incorporating heating ducts are obtainable under the Part Nos.

111 801 041 B (151 801 023 B), left

111 801 042 B (151 801 024 B), right.

### Service Installation

A subsequent installation on earlier cars is advisable only if both body side members call for a replacement to insure that the two outlets are exactly opposite each other. When assembling new side members with earlier cowl side panels, care should be taken to insure that there is sufficient free space between flexible heating pipe and instrument panel pillar (Part No. 111 805 115/116). Bend the pillar inward, as found necessary.

Earlier side members are still obtainable under the old part numbers.

## Karmann Ghia Coupé

### Heating

Commencing with Chassis No. 1 128 610, Body No. 3001, the heating vents in the side members are positioned further toward the rear as illustrated by the drawing overleaf. If required, this modification can be incorporated in earlier cars as recommended below.

- 1 - Remove mat from front end of body side member.
- 2 - Mark the hole to be cut for the new louver plate (4).
- 3 - Insert the guide plate (1), with a strip of felt (2) cemented to it, into the side member, drill two 1.7 mm (.07") holes and fix the plate with the tapping screws I and II (Note dimension "b". From Body No. 1 - 1440 onwards, shorten the deflector plate for the windshield defroster duct by "c" = 30 mm/1.18", using an electric drill).



4 - Attach louver plate (4) by drilling two 1.7 mm (.07") holes and using tapping screws III and IV.

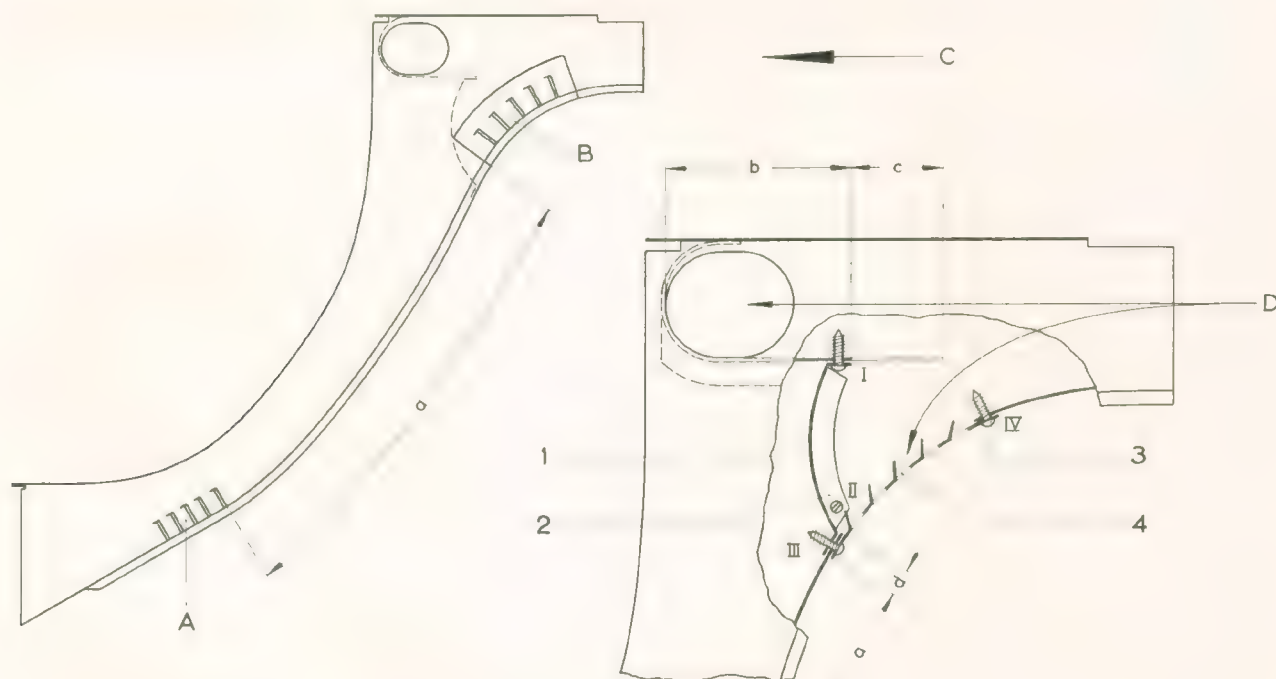
**Note.** - Instead of using tapping screws I, III, IV, the plates can be spot-welded in position.

5 - Blank off old outlet hole with imitation leather.

6 - Cut hole for new outlet into mat and bind the edge.

7 - Cement mat to side member.

The parts required for the modification should be ordered from the manufacturer: Karmann GmbH., Fahrzeugbau, Osnabrück, Germany.



A = Earlier outlet

B = New outlet

C = Front of car

D = Air flow

a = 270 mm (10.63")

b = 64 mm (2.52")

c = 30 mm (1.18")

d = 10 mm (0.79")

1 = Deflector plate

2 = Felt strip

3 = Round-head tapping screw S 2.2 x 9.5

4 = Louver plate

## Gauze Screen for Ventilator Intakes

From Body No. 6951 onwards, the ventilator intake openings are additionally provided with gauze screens (Part Nos. 141 255 971/972) of the fine mesh of 1 mm (.04") to guard against the ingress of insects and dirt.

The new screens can be installed on all earlier Coupés behind the grilles at the air intake openings.

## Defroster Vent

With effect from Sept. 16th, 1957, Chassis No. 1 649 253, Body No. 22 922, the Karmann Ghia Coupé is additionally provided with a defroster vent at the rear view window. This will prevent the rear view window from misting up. The warm air is taken from the right-hand heater pipe below the rear seat. The warm air supply is switched on with the car heating.

Service installation in vehicles of older version is possible if a flange is welded to the right-hand heater pipe and an opening cut into the sheet metal of the tray below the rear view window. The following parts are needed:

| Number | Designation  | Part No.    |
|--------|--------------|-------------|
| 1      | Baffle       | 143 255 651 |
| 1      | Heating tube | 143 255 655 |
| 1      | Vent         | 143 255 659 |

For details as to service installation see Technical Bulletin A 12.



# Tools and Appliances



## 1 - VW Special Service Tools

VW 122 b      Circlip Pliers

## 2 - VW Workshop Equipment for Local Manufacture

|            |                                              |
|------------|----------------------------------------------|
| VW 602     | Body Trolley                                 |
| VW 603/1/2 | Vehicle Trolley                              |
| VW 605     | Gantry Crane                                 |
| VW 700     | Tank Mounting Template                       |
| VW 701     | Engine Compartment Template                  |
| VW 702     | Front Wing Template                          |
| VW 703     | Rear Wing Template                           |
| VW 704     | Body Front End Template                      |
| VW 705     | Rear Bumper Bracket Template                 |
| VW 706     | Rear Side Panel Bracket Template             |
| VW 730     | Door Hinge Pin Removal Tool                  |
| VW 730/1   | Door Hinge Pin Drift                         |
| VW 731     | Expander for Body Straightener               |
| VW 732     | Body Parting Tool                            |
| VW 733     | Body Parting Tool (Pneumatic)                |
| VW 734     | Rain Drip Mould Deflanging Tool              |
| VW 735     | Lever Jack                                   |
| VW 736     | Headlining Tool                              |
| VW 737     | Vent Wing Glass Removing and Installing Tool |

## 3 - Normal Hand Tools

Screwdriver, 6 mm  
Screwdriver, 8 mm  
Combination pliers  
Pipe wrench  
Cold chisel  
Cape chisel  
Prick punch (center punch)  
Punch, 2 mm  
Punch, 4 mm  
Mechanic's hammer, 300 grams  
Mechanic's hammer, 500 grams  
Rubber mallet, 85 x 50 mm  
Aluminum mallet  
Triangular scraper  
Flat scraper  
Flat file, 180 mm in length  
Round file, 180 mm in length  
Half-round file, 180 mm in length  
Socket wrench, 14 mm  
Socket wrench, 17 mm  
Phillips screwdriver, 3 mm  
Phillips screwdriver, 5 mm  
Open-end wrench, 14 mm  
Box wrench, 14 mm  
Wire brush  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl



Caliper square, 300 mm in length, measuring 1/50 mm  
 Tap M 6  
 Tap M 8  
 Tap M 10  
 Tap wrench, size 1, adjustable  
 Tap wrench, size 2, adjustable  
 Die M 6  
 Die M 8  
 Die M 10  
 Die stock, size 1  
 Die stock, size 2  
 Drill, 5.0 mm  
 Drill, 6.7 mm  
 Drill, 7.0 mm  
 Drill, 8.5 mm  
 Drill, 9.0 mm  
 Inspection lamp with cable and plug  
 Electric drill, 0—12 mm  
 Torque wrench, 0—6 mkg  
 Set of body tools (incl. hammers, spoons, file holders, and dolly blocks)  
 Pneumatic tool

#### **4 - Supplementary Workshop Equipment**

Spot welding plant  
 Spot gun, 120 mm range  
 Spot gun, 300 mm range  
 Spot gun, 550 mm range  
 Spot gun, 650 mm range  
 Portable grinding machine  
 Sanding disc  
 Gas welding plant with torches of various sizes



## Contents:

**1 - Description of Electrical System**

**2 - Generator**

**3 - Starting Motor**

**4 - Battery**

**5 - Ignition System**

**6 - Lighting System**

**7 - Electrical Accessories**

**8 - Instruments**

**9 - Radio**

**10 - Special Hints**

**11 - Tools and Appliances**



# Description of Electrical System

# E

## Generator

The six-volt electrical system is operated by a generator having a nominal output of 130 watts at 2600 r.p.m. The generator output is controlled by a regulator. A generator warning light is found on the speedometer dial at the left-hand bottom.

## Starting Motor

The solenoid starting motor of the overrunning-clutch type produces 0.4 HP. It is operated by the ignition key.

## Battery

The six-volt battery consists of three cells and has a capacity of 70 amp. hours at a twenty-hour discharge rate. The battery is located on the right-hand side of the frame under the rear seat and is securely held in position by a metal strap. The negative terminal of the battery is grounded.

## Ignition

The battery supplies the low tension current which is converted to high tension current by the ignition coil. The distributor incorporates a centrifugal spark-advance mechanism. The ignition switch is located on the right-hand side of the instrument panel. A combined steering lock and ignition switch is available for service installation.

## Lighting System

The built-in headlamps incorporate filaments for the high beam, low beam, and parking light. The reflectors are horizontally and vertically adjustable. The main lighting switch is of the push-pull type and has three positions. The selection of the high or low beam is done by means of a foot-controlled switch on the left-hand side of the clutch cable. A switched-on high beam is indicated by a blue light in the upper half of the speedometer dial.

The rear lighting is done by two tail lights on the fenders and a license plate light on the rear hood. The two stop lights are combined with the tail lights in bezels on the rear fender. On the De Luxe Model, the stop light is operated by a switch at the brake master cylinder. On the Standard Model, the stop light switch is situated behind the frame head cover and is operated by the foot brake push bar.

An oil pressure switch, in connection with a green warning light in the speedometer dial indicates a faulty oil circulation.

The interior light in the left-hand roof side member above the door pillar is controlled by a tumbler switch on the left-hand side below the instrument panel. On the De Luxe Model, the interior light is automatically switched on by the door contact switches when opening the doors. Additionally, a manual switch at the interior light allows the light to be switched off with the doors open. The speedometer light goes on when placing the interior light switch to the right.

The socket at the left-hand side of the front hood lock control knob is for connecting an inspection lamp.

## Electrical Accessories

The horn is operated by a sliding contact at the steering column when pressing the button in the center of the steering wheel.

The built-in direction indicators at the door hinge pillars are operated by the switch below the steering wheel. The two arrows in the speedometer dial tell the driver that one of the indicators sticks out.

The windshield wiper motor, which operates two blades, is set into motion by a push-pull type switch on the instrument panel. The windshield wipers of the De Luxe Model are self-parking.



The fuse box for the headlamps, windshield wipers, and horn is located underneath the front hood, on the left-hand side next to the fuel tank. Another fuse box, carrying fuses for tail and stop lights, direction indicator switch, interior light, and inspection lamp socket, is found on the back of the instrument panel.

## Instruments

Speedometer and mileage recorder are driven by the left-hand front wheel through a cable.

### **Note:**

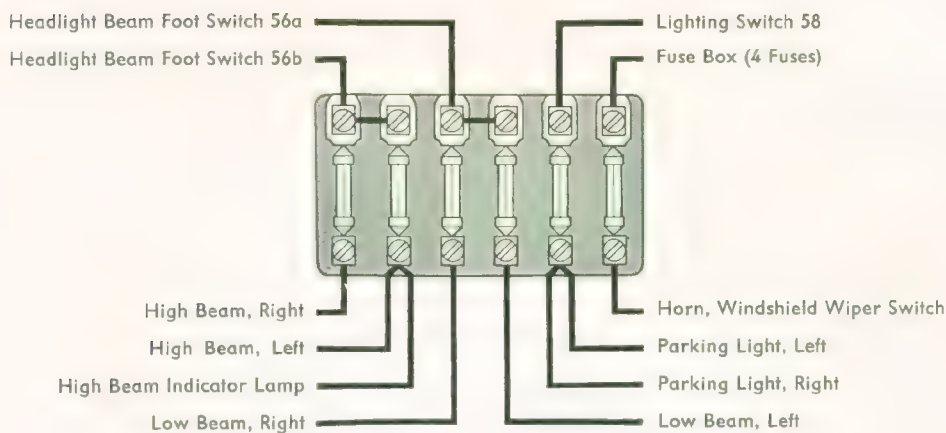
Repairs on the electrical system are generally limited to a removal of defective or worn components and a reconditioning of the wiring. To avoid excessive tension or a voltage drop, it is important to use cables of the same cross section when renewing (see key to wiring diagram).

Repairs on BOSCH parts should, if possible, be carried out by BOSCH Service Stations. The electrical system service is fully described on the following pages.

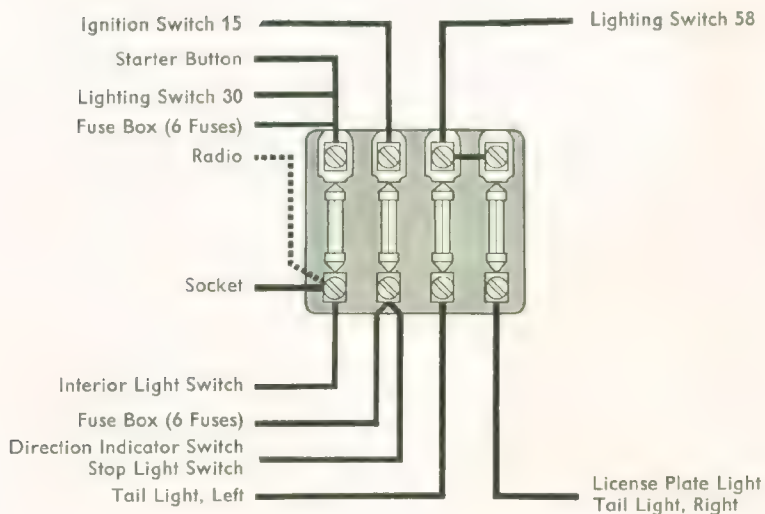
### **Important!**

To avoid short circuits, the positive cable should be disconnected from the battery whenever an operation on the electrical system necessitates a detaching of cables.

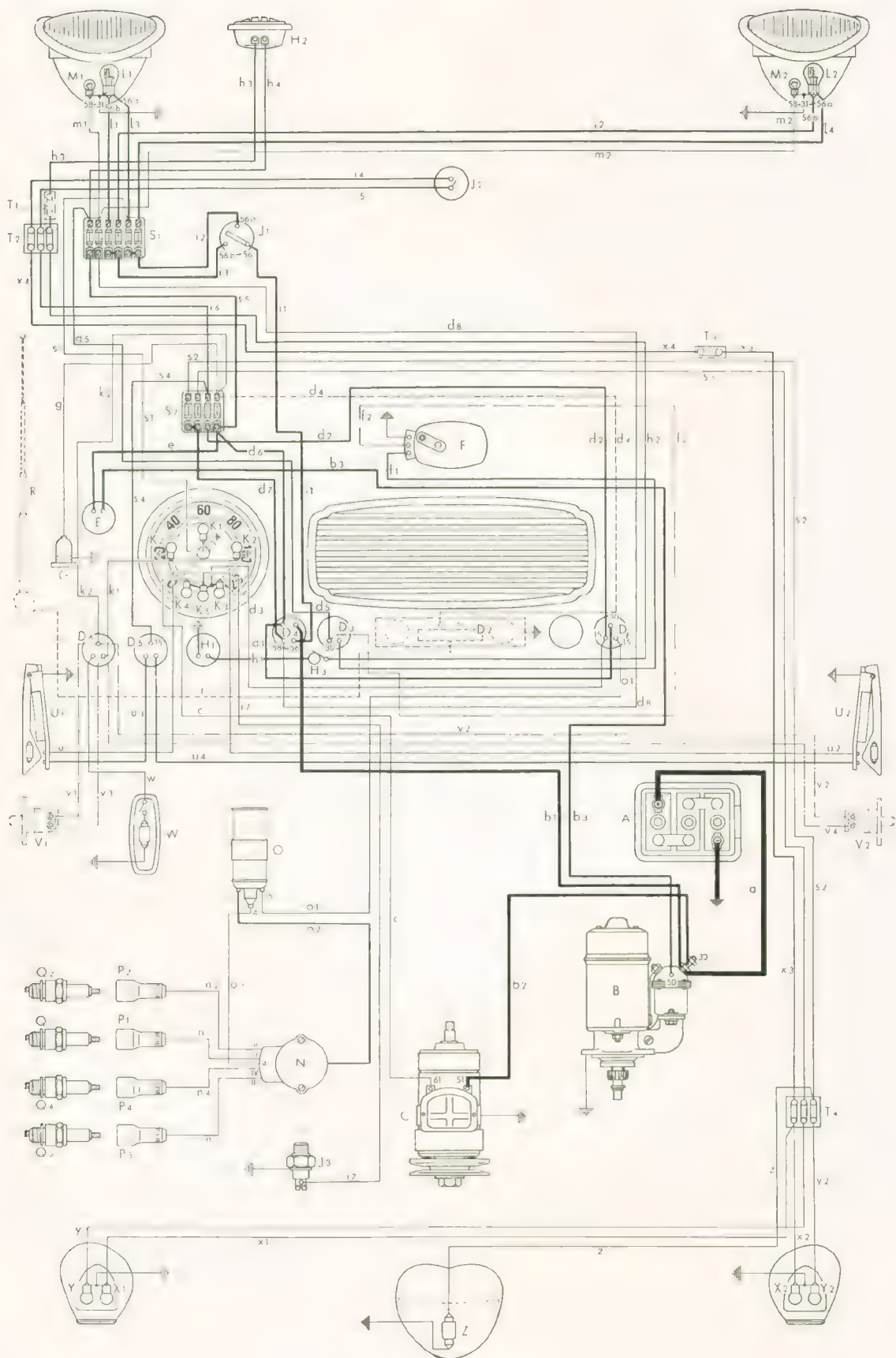
## Fuses



**Fuse Box S 1 on the left side next to the fuel tank**



**Fuse Box S 2 on the back of the instrument panel**





## Key to Part Designations

|                                                                  |                                                |
|------------------------------------------------------------------|------------------------------------------------|
| A - Battery                                                      | N - Ignition Distributor                       |
| B - Starting Motor                                               | O - Ignition Coil                              |
| C - Generator                                                    | P <sub>1</sub> - Spark Plug Connector (Plug 1) |
| D <sub>1</sub> - Ignition Switch                                 | P <sub>2</sub> - Spark Plug Connector (Plug 2) |
| D <sub>2</sub> - Radio ***                                       | P <sub>3</sub> - Spark Plug Connector (Plug 3) |
| D <sub>3</sub> - Windshield Wiper Switch                         | P <sub>4</sub> - Spark Plug Connector (Plug 4) |
| D <sub>4</sub> - Lighting Switch                                 | Q <sub>1</sub> - Spark Plug for Cylinder 1     |
| D <sub>5</sub> - Direction Indicator Switch                      | Q <sub>2</sub> - Spark Plug for Cylinder 2     |
| D <sub>6</sub> - Tumbler Switch (Instrument and interior lights) | Q <sub>3</sub> - Spark Plug for Cylinder 3     |
| E - Starter Button                                               | Q <sub>4</sub> - Spark Plug for Cylinder 4     |
| F - Windshield Wiper Motor                                       | R - Radio Antenna ***                          |
| G - Socket                                                       | S <sub>1</sub> - Fuse Box (six fuses)          |
| H <sub>1</sub> - Horn Button                                     | S <sub>2</sub> - Fuse Box (four fuses)         |
| H <sub>2</sub> - Horn                                            | T <sub>1</sub> - Connector *                   |
| H <sub>3</sub> - Horn Brush                                      | T <sub>2</sub> - Connector **                  |
| J <sub>1</sub> - Headlight Dimmer Switch                         | T <sub>3</sub> - Connector                     |
| J <sub>2</sub> - Stop Light Switch                               | T <sub>4</sub> - Connector                     |
| J <sub>3</sub> - Oil Pressure Switch                             | U <sub>1</sub> - Direction Indicator, Left     |
| K <sub>1</sub> - High Beam Indicator Lamp                        | U <sub>2</sub> - Direction Indicator, Right    |
| K <sub>2</sub> - Instrument Light Bulbs                          | V <sub>1</sub> - Door Contact Switch, Left *   |
| K <sub>3</sub> - Oil Pressure Warning Light                      | V <sub>2</sub> - Door Contact Switch, Right *  |
| K <sub>4</sub> - Generator and Cooling Warning Light             | W - Interior Light                             |
| K <sub>5</sub> - Direction Indicator Light (Two arrows)          | X <sub>1</sub> - Stop Light, Left              |
| L <sub>1</sub> - Two-Filament Bulb, Left                         | X <sub>2</sub> - Stop Light, Right             |
| L <sub>2</sub> - Two-Filament Bulb, Right                        | Y <sub>1</sub> - Tail Light, Left              |
| M <sub>1</sub> - Parking Light, Left                             | Y <sub>2</sub> - Tail Light, Right             |
| M <sub>2</sub> - Parking Light, Right                            | Z - License Plate Light                        |

## Key to Cable Colours

| Designation    | Colour               | Cross Section sq. mm. | Designation    | Colour               | Cross Section sq. mm. | Designation    | Colour            | Cross Section sq. mm. |
|----------------|----------------------|-----------------------|----------------|----------------------|-----------------------|----------------|-------------------|-----------------------|
| a              | Black                | 25.0                  | i <sub>2</sub> | White                | 2.5                   | s <sub>1</sub> | Blue/White        | 0.5                   |
| b <sub>1</sub> | Red                  | 6.0                   | i <sub>3</sub> | Yellow               | 2.5                   | s <sub>2</sub> | Grey/Red          | 0.75                  |
| b <sub>2</sub> | Red/Black            | 6.0                   | i <sub>4</sub> | Black/Red            | 1.0                   | s <sub>3</sub> | Grey/Black        | 0.75                  |
| b <sub>3</sub> | Red                  | 2.5                   | i <sub>5</sub> | Black/Red            | 1.0                   | s <sub>4</sub> | Black/White/Green | 1.0                   |
| c              | Blue                 | 0.5                   | i <sub>6</sub> | Black/Red            | 1.0                   | s <sub>5</sub> | Black             | 1.5                   |
| d <sub>1</sub> | Red                  | 2.5                   | i <sub>7</sub> | Blue/Green           | 0.5                   | u <sub>1</sub> | Blue/Red          | 0.5                   |
| d <sub>2</sub> | Black                | 1.5                   | k <sub>1</sub> | Grey/Red             | 0.5                   | u <sub>2</sub> | Blue/Red          | 0.5                   |
| d <sub>3</sub> | Black                | 0.5                   | k <sub>2</sub> | Black                | 0.5                   | u <sub>3</sub> | Black/White       | 1.0                   |
| d <sub>4</sub> | Service Installation |                       | l <sub>1</sub> | Yellow/Black         | 1.5                   | u <sub>4</sub> | Black/Green       | 1.0                   |
| d <sub>5</sub> | Black                | 1.0                   | l <sub>2</sub> | Yellow               | 1.5                   | v <sub>1</sub> | Grey/Green *      | 0.75                  |
| d <sub>6</sub> | Black                | 1.5                   | l <sub>3</sub> | White/Black          | 1.5                   | v <sub>2</sub> | Grey/Green *      | 0.75                  |
| d <sub>7</sub> | Grey/Black           | 2.5                   | l <sub>4</sub> | White                | 1.5                   | v <sub>3</sub> | Grey/Green *      | 0.75                  |
| d <sub>8</sub> | Grey/Yellow          | 0.5                   | m <sub>1</sub> | Grey/Black           | 0.5                   | v <sub>4</sub> | Grey/Green *      | 0.75                  |
| e              | Red                  | 2.5                   | m <sub>2</sub> | Grey                 | 0.5                   | w              | Grey/Green        | 0.5                   |
| f <sub>1</sub> | Black/Lilac          | 1.0                   | n <sub>1</sub> | Black                | 0.85                  | x <sub>1</sub> | Black/Red         | 0.75                  |
| f <sub>2</sub> | Black *              | 1.0                   | n <sub>2</sub> | Black                | 0.85                  | x <sub>2</sub> | Black/Red         | 0.75                  |
| g              | Red                  | 0.75                  | n <sub>3</sub> | Black                | 0.85                  | x <sub>3</sub> | Black/Red         | 1.0                   |
| h <sub>1</sub> | Black                | 1.5                   | n <sub>4</sub> | Black                | 0.85                  | x <sub>4</sub> | Black/Red         | 1.0                   |
| h <sub>2</sub> | Brown                | 1.0                   | o <sub>1</sub> | Black                | 0.75                  | y <sub>1</sub> | Grey/Black        | 0.75                  |
| h <sub>3</sub> | Brown                | 1.0                   | o <sub>2</sub> | Green                | 1.5                   | y <sub>2</sub> | Grey              | 0.75                  |
| h <sub>4</sub> | Black/Yellow         | 1.0                   | o <sub>3</sub> | Black                | 0.85                  | z              | Grey/Red          | 0.5                   |
| i <sub>1</sub> | White/Black          | 2.5                   | r              | Service Installation |                       |                |                   |                       |

\* = De Luxe only

\*\* = Standard only

\*\*\* = Service installation only



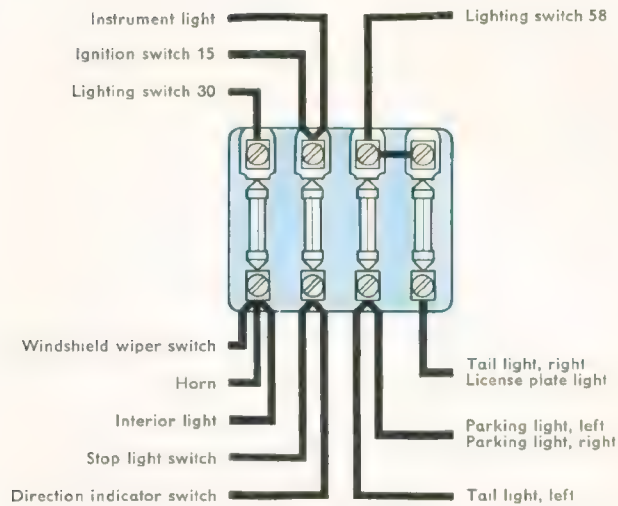
# Wiring Diagram and Fuses

(Sedan and Convertible)

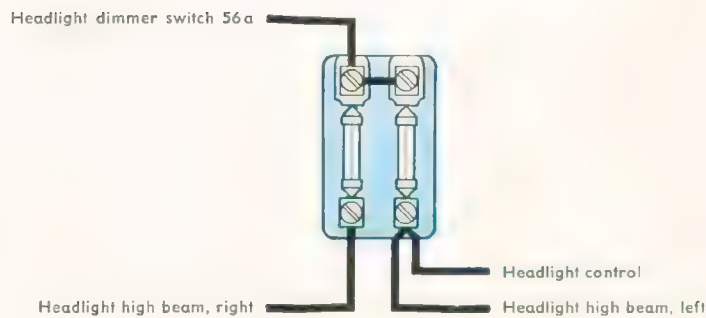
From January 1954

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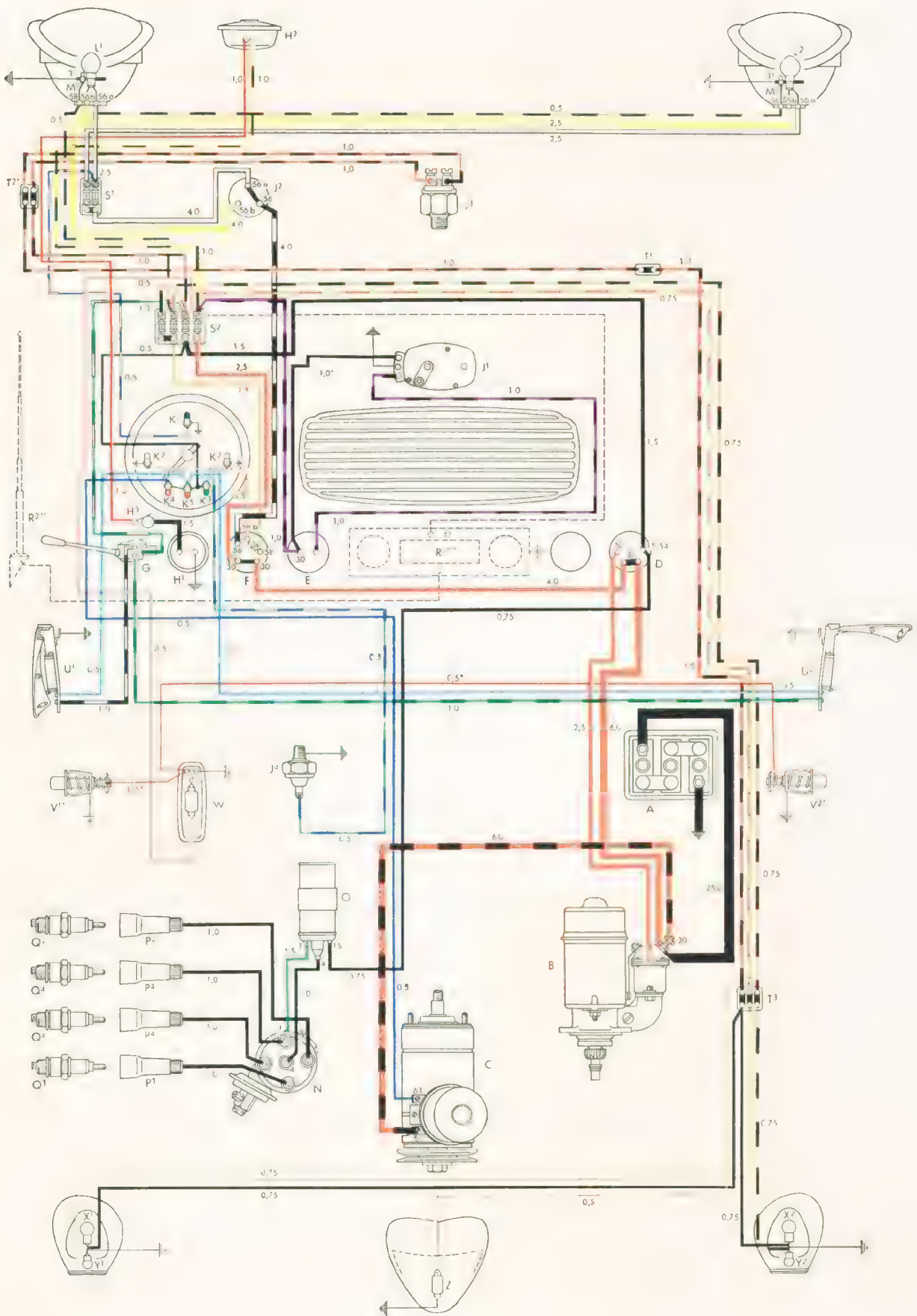
## Fuses



**Fuse box on the back of the instrument panel**



**Fuse box beside the fuel tank**





## Key to Part Designations

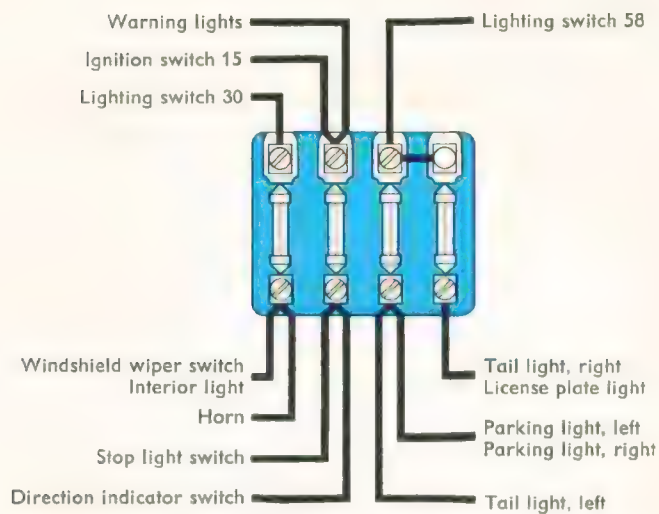
A - Battery  
 B - Starting Motor  
 C - Generator  
 D - Ignition Switch  
 E - Windshield Wiper Switch  
 F - Lighting Switch  
 G - Direction Indicator Switch  
 H<sub>1</sub> - Horn Button  
 H<sub>2</sub> - Horn  
 H<sub>3</sub> - Horn Brush  
 I<sub>1</sub> - Windshield Wiper Motor  
 I<sub>2</sub> - Headlight Dimmer Switch  
 I<sub>3</sub> - Stop Light Switch  
 I<sub>4</sub> - Oil Pressure Switch  
 K<sub>1</sub> - High Beam Warning Light  
 K<sub>2</sub> - Instrument Light Bulbs  
 K<sub>3</sub> - Oil Pressure Warning Light  
 K<sub>4</sub> - Generator and Cooling Warning Light  
 K<sub>5</sub> - Direction Indicator Warning Light  
 L<sub>1</sub> - Two-Filament Bulb, left  
 L<sub>2</sub> - Two-Filament Bulb, right  
 M<sub>1</sub> - Parking Light, left  
 M<sub>2</sub> - Parking Light, right  
 N - Ignition Distributor  
 O - Ignition Coil  
 P<sub>1</sub> - Spark Plug Connector (Cylinder 1)  
 P<sub>2</sub> - Spark Plug Connector (Cylinder 2)  
 P<sub>3</sub> - Spark Plug Connector (Cylinder 3)  
 P<sub>4</sub> - Spark Plug Connector (Cylinder 4)  
 Q<sub>1</sub> - Spark Plug for Cylinder 1  
 Q<sub>2</sub> - Spark Plug for Cylinder 2  
 Q<sub>3</sub> - Spark Plug for Cylinder 3  
 Q<sub>4</sub> - Spark Plug for Cylinder 4  
 R<sub>1</sub> - Radio\*\*\*)  
 R<sub>2</sub> - Radio Antenna\*\*\*)  
 S<sub>1</sub> - Fuse Box beside the Fuel Tank  
 S<sub>2</sub> - Fuse Box on the Back of the Instrument Panel  
 T<sub>1</sub> - Connector  
 T<sub>2</sub> - Connector\*\*)  
 T<sub>3</sub> - Connector  
 U<sub>1</sub> - Direction Indicator, left  
 U<sub>2</sub> - Direction Indicator, right  
 V<sub>1</sub> - Door Contact Switch, left\*)  
 V<sub>2</sub> - Door Contact Switch, right\*)  
 W - Interior Light  
 X<sub>1</sub> - Stop Light, left  
 X<sub>2</sub> - Stop Light, right  
 Y<sub>1</sub> - Tail Light, left  
 Y<sub>2</sub> - Tail Light, right  
 Z - License Plate Light

\*) De Luxe only

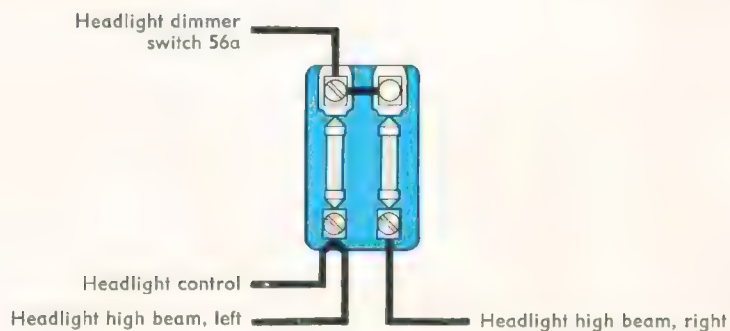
\*\*) Standard only

\*\*\*) Service Installation only

## Fuses



**Fuse box on the back of the instrument panel**



**Fuse box adjacent to the fuel tank**





## Key to Colour Marking in Wiring Diagram Type 1

|                                                                   |                                                               |
|-------------------------------------------------------------------|---------------------------------------------------------------|
| A - Battery                                                       | Q <sup>1</sup> - Spark Plug for Cylinder 1                    |
| B - Starting Motor                                                | Q <sup>2</sup> - Spark Plug for Cylinder 2                    |
| C - Generator                                                     | Q <sup>3</sup> - Spark Plug for Cylinder 3                    |
| D - Ignition/Starting Switch                                      | Q <sup>4</sup> - Spark Plug for Cylinder 4                    |
| E - Windshield Wiper Switch                                       | R <sup>1</sup> - Radio                                        |
| F - Lighting Switch with Rheostat Control for Instrument Lighting | R <sup>2</sup> - Radio Antenna                                |
| G - Direction Indicator Switch (semaphore)                        | S <sup>1</sup> - Fuse Box on the Back of the Instrument Panel |
| G <sup>1</sup> - Direction Indicator Switch (flashing)            | S <sup>2</sup> - Fuse Box adjacent to the Fuel Tank           |
| H <sup>1</sup> - Horn Button                                      | T <sup>1</sup> - Connector                                    |
| H <sup>2</sup> - Horn Brush                                       | T <sup>2</sup> - Connector                                    |
| H <sup>3</sup> - Horn                                             | T <sup>3</sup> - Connector                                    |
| J <sup>1</sup> - Flasher Unit                                     | T <sup>4</sup> - Connector                                    |
| J <sup>2</sup> - Headlight Dimmer Switch                          | T <sup>5</sup> - Connector                                    |
| J <sup>3</sup> - Stop Light Switch                                | T <sup>6</sup> - Connector                                    |
| J <sup>4</sup> - Oil Pressure Switch                              | U <sup>1</sup> - Direction Indicator (semaphore), left        |
| K <sup>1</sup> - High Beam Warning Light                          | U <sup>2</sup> - Direction Indicator (semaphore), right       |
| K <sup>2</sup> - Generator and Cooling Warning Light              | U <sup>3</sup> - Direction Indicator (flashing), left         |
| K <sup>3</sup> - Direction Indicator Warning Light                | U <sup>4</sup> - Direction Indicator (flashing), right        |
| K <sup>4</sup> - Oil Pressure Warning Light                       | V <sup>1</sup> - Door Contact Switch, left                    |
| K <sup>5</sup> - Instrument Light Bulbs                           | V <sup>2</sup> - Door Contact Switch, right                   |
| L <sup>1</sup> - Two-Filament Bulb, left                          | W - Windshield Wiper Motor                                    |
| L <sup>2</sup> - Two-Filament Bulb, right                         | X <sup>1</sup> - Stop and Tail Light, left                    |
| M <sup>1</sup> - Parking Light, left                              | X <sup>2</sup> - Stop and Tail Light, right                   |
| M <sup>2</sup> - Parking Light, right                             | Y - Interior Light                                            |
| N - Ignition Distributor                                          | Z - License Plate Light                                       |
| O - Ignition Coil                                                 |                                                               |
| P <sup>1</sup> - Spark Plug Connector (Cylinder 1)                | ① - Battery Ground Strap                                      |
| P <sup>2</sup> - Spark Plug Connector (Cylinder 2)                | ② - Steering Column Flange Ground Strap                       |
| P <sup>3</sup> - Spark Plug Connector (Cylinder 3)                | ③ - Ground Strap between Transmission and Frame               |
| P <sup>4</sup> - Spark Plug Connector (Cylinder 4)                |                                                               |

Black = All Models

Blue = Standard and De Luxe

Green = Standard

Brown = De Luxe

Red = Special Equipment Required in Some Countries

Grey = Service Installation

## General Description

**Make: BOSCH RED 130/6 2600 AL 16**

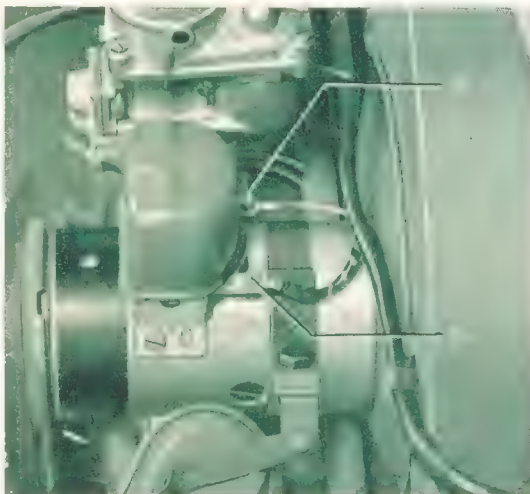
The output of the generator is controlled by the regulator BOSCH RS/G 130/6/11. The output of 130 watts at 2600 r.p.m. corresponds to 1300 r.p.m. of the crankshaft (43 km/h. = 27 m.p.h.) in top gear. The generator is attached to its support by means of a strap. The armature is supported by a single-thrust ball bearing on either side. The armature shaft carries an adjustable pulley on the commutator side and the fan on the opposite side.

The generator regulator consists of two independent units encased in a sealed, moisture-proof and dirt-proof box mounted on the generator. The function of the cutout relay or circuit breaker is to close the circuit between the generator and the battery when the generator is producing current and to open this circuit so that the battery cannot discharge back through the generator when the generator slows or stops. The current limiting regulator and voltage regulator are designed to prevent the output and voltage of the generator from exceeding the predetermined safe maximum. It is important only to use a regulator which corresponds to the nominal output of the generator. A regulator designed to suit a higher output would lead to overcharging, while a regulator for a lower output would cause the generator to produce insufficient current for the electric circuit.

### Connections:

Terminal 51 to terminal 30 at the starting motor.

Terminal 61 to generator warning lamp.

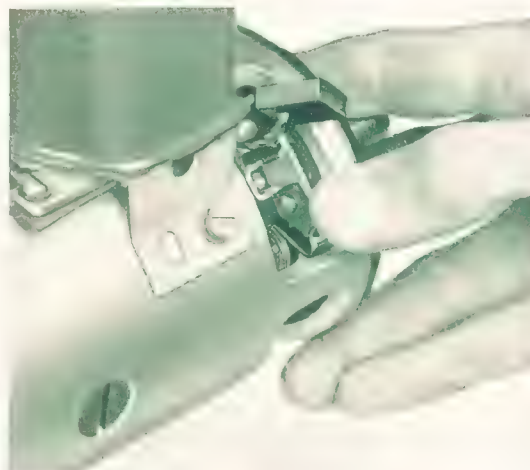


### Note:

From Chassis No. 1 - 0 541 307 a new generator with an output of 160 watts at 2600 r.p.m. is being used. This generator may also be installed on earlier vehicles.

## Inspections and Maintenance

The ball bearings of the generator are packed with BOSCH High Melting Point Grease and require no attention under normal conditions. Lubrication is, in general, only carried out when the engine is undergoing an overhaul. Never use ordinary grease! The brush gear should be inspected approx. every 10,000 km (6,000 miles). Worn brushes should be replaced (BOSCH DSK 2/38 z). The regulator requires no maintenance attention.



## Generator Warning Lamp

### General Description

A red lamp is connected to a cable between terminals 51 and 61 of the regulator to provide an indication when the ignition is switched on. This lamp lights up when the engine is stationary or running slowly and goes out when the generator commences to charge.

The lamp also provides a control over the fan belt and the cooling fan. If the belt breaks, the generator and fan cease to revolve and the lamp lights up.

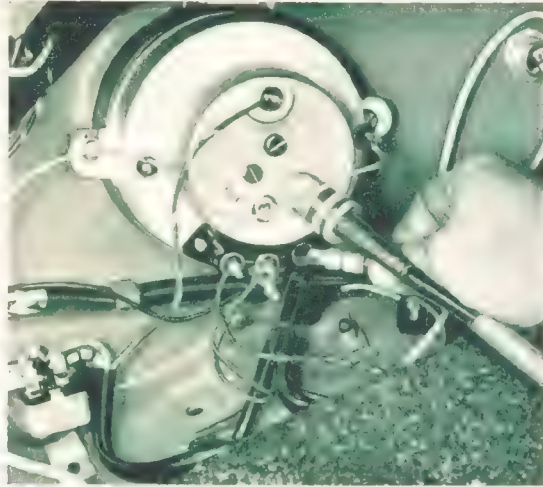
### Lamp Type:

Indicator lamp J 6 V 1.2 W DIN 72 601

### Bulb replacement

The lamp is accessible by opening the front hood and removing the instrument panel protection lining from the speedometer.

1 - Remove socket and bulb from the speedometer.



2 - Slightly press bulb into its socket, turn it to the left and pull it out.

3 - Install new bulb in reverse order.

## Testing Generator and Regulator

The fact that the generator warning lamp goes out after starting and when the engine picks up speed is not in itself a definite indication of a proper regulator setting and adequate charging of the battery. A test of the generator can first be carried out

with the generator in the car. A good electric current and voltage testing instrument or a moving coil-type voltmeter (calibrated 0—30 volts) and a moving coil-type ammeter (calibrated 30—0—30 amperes) are required.

## Testing Regulator Voltage

1 - Disconnect cable from terminal 51 at the regulator. Connect the positive lead of a moving coil-type voltmeter to terminal 51 at the regulator and ground the negative lead.

2 - Start engine. Increase the engine speed gradually from idle (approx. 500 r.p.m.) to 1750—2000 r.p.m., which corresponds to a generator speed of 3500—4000 r.p.m. The hand should jump from 0 to 6—7 volts at increased idling speed and should then constantly register between 7.3 and 8.6 volts (correct: 8.1 volts at room temperature of 20° C = 68° F), provided that the regulator is correctly set.

3 - When stopping the engine, watch carefully for the flicking back of the voltmeter hand, which indicates that the cutout relay is correctly operating.





## Testing Charging Current

It may happen that the battery is not properly charged even when the regulator is correctly set. To check the charging current proceed as follows:

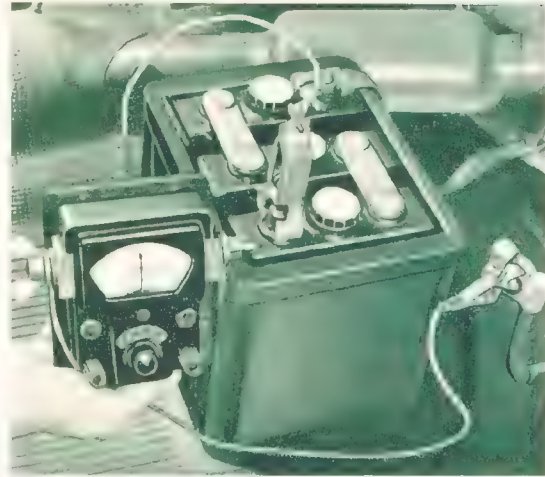
- 1 - Disconnect positive cable from battery and connect ammeter between cable and positive terminal at battery. If no electrical units are switched on, the ammeter hand must remain in zero position. The system is otherwise at fault.

- 2 - Switch on ignition or any light:

The hand must move to one side, indicating the supply of current in amperes.

- 3 - Start engine:

The hand must move to the opposite side as the speed increases. The charging circuit is otherwise not closed.



The indicated value of the charging current does not give evidence whether or not the regulator is correctly set, as the amount of the charging current depends on the state of charge of the battery.

## Testing Current Regulator

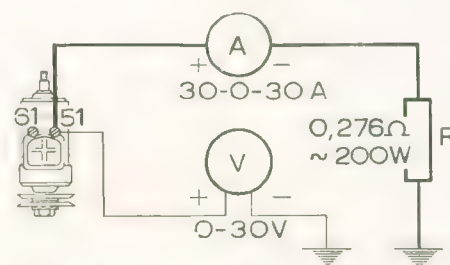
To check the current regulator independently of the state of charge of the battery you require:

- a - a moving coil-type voltmeter calibrated 0—30 volts,
- b - a moving coil-type ammeter calibrated 30—0—30 amperes,
- c - a fixed resistance of 0.276 ohms, suitable for a load of 25 amperes.

The check can be carried out with the generator in position on the vehicle or on the test bench.

- 1 - Disconnect cable from terminal 51 at the regulator.
- 2 - Connect the resistance in series with the ammeter between terminal 51 at the regulator and ground.
- 3 - Connect positive lead of voltmeter to terminal 51 at the regulator and ground the negative lead.
- 4 - Start engine. With the generator running at a speed of 3500—4000 r.p.m., the load should

be approx. within 23—26.5 amperes at a voltage between 6.4—7.3 volts.



If the readings are not within these limits, the regulator should be replaced. Re-setting or repairing the regulator is in all cases up to a special workshop which is equipped with the testing appliances required. Any interference with the regulator system, as a cleaning or remachining of the contact points, may completely alter the electrical adjustments, causing great damage to the electrical system.

## Removing and Installing Regulator

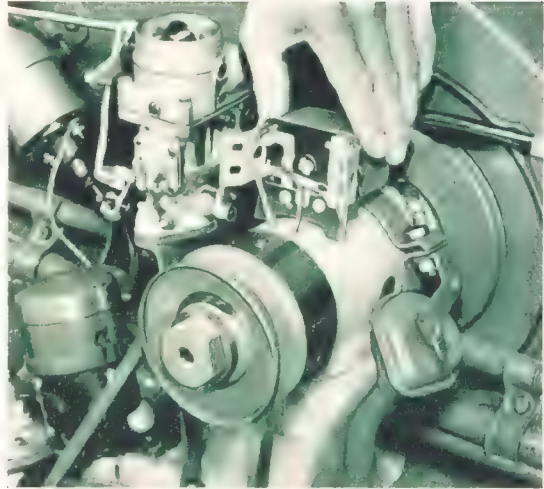
### Removal

- 1 - Disconnect cables from terminals 51 and 61 at the regulator.
- 2 - Remove the slotted screws that attach the regulator to the generator and take off regulator.
- 3 - Disconnect the two cables from the terminals marked "+" and "F" at the bottom of the regulator.

### Installation

This is a reversal of the above procedure, but the following points should be heeded:

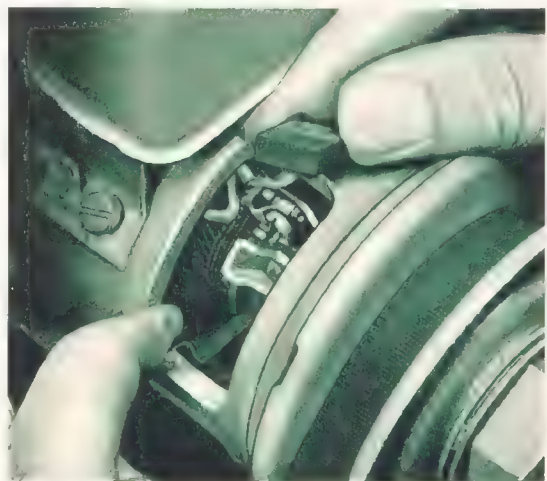
- 1 - The thicker cable comes from the positive brush and must be connected to the terminal "+" at the bottom of the regulator.
- 2 - The thinner cable comes from the field coils and must be connected to the terminal "F" at the bottom of the regulator.



If, after replacement of the regulator, the readings are still not within the limits mentioned under "Testing Current Regulator", the generator is faulty.

## Checking Brushes and Commutator

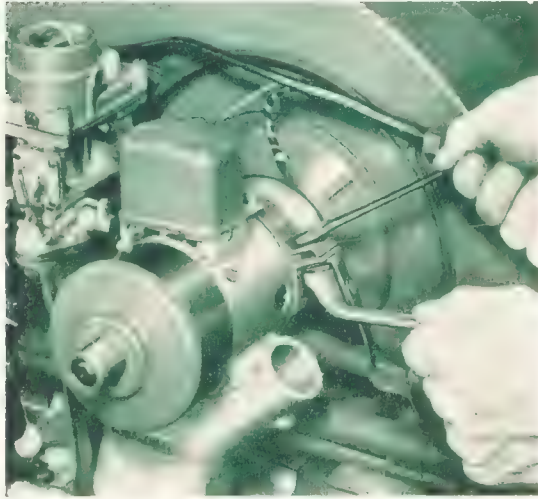
- 1 - Remove generator cover band.
- 2 - Examine brushes for wear and make a check to insure that the brushes are free in their guides. If the brushes are worn so that they do not bear on the commutator, or if they are oil-soaked, new brushes of the same type (DSK 2/38 z) must be fitted.
- 3 - If the commutator is blackened, dirty or oily, use a clean cloth dampened with fuel and a piece of wood. Make sure that no dirt enters the ball bearing.
- 4 - Check brush spring tension. Renew weak springs.
- 5 - If the commutator is worn, rough or burned, the generator should be disassembled for overhaul.



## Removing and Installing Generator

### Removal

- 1 - Disconnect cables from regulator.
- 2 - Take off fan belt.
- 3 - Release generator mounting strap.



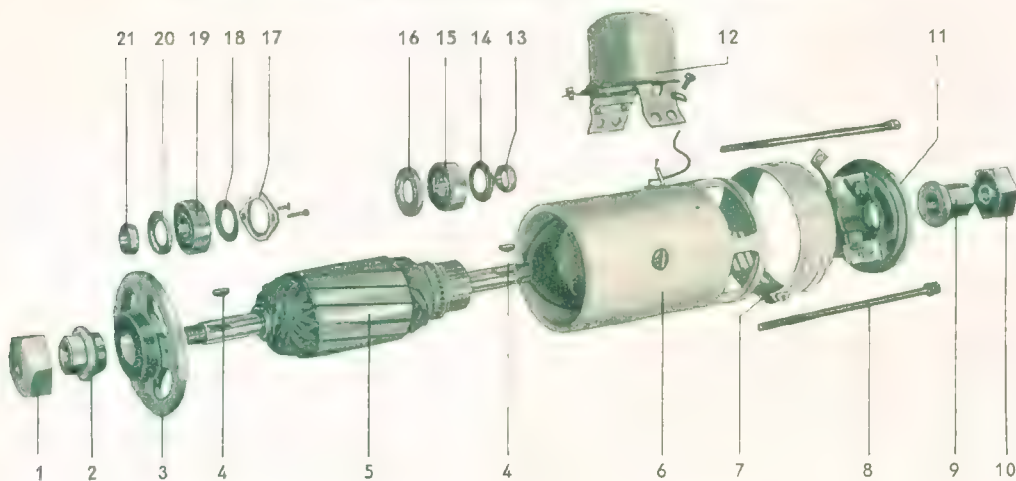
- 4 - Remove throttle ring and the screws on both sides of the fan housing and slightly lift up the fan housing.
- 5 - Remove ignition cables and projecting tube.
- 6 - Remove four screws on fan cover and take off generator.

### Installation

This is a reversal of the operations described above, but attention should be paid to the points below:

- 1 - Make sure that the paper gasket is on the generator support.
- 2 - Note concentric positions of throttle ring with air intake flange.
- 3 - Connect red cable to terminal 51 at the regulator.
- 4 - Connect blue cable to terminal 61 at the regulator.

## Disassembly and Assembly of Generator



- 1 - Fan Nut
- 2 - Fan Hub
- 3 - End Plate
- 4 - Woodruff Key
- 5 - Armature
- 6 - Frame and Field Assembly
- 7 - Cover Band
- 8 - Through Bolt and Lockwasher
- 9 - Pulley Hub
- 10 - Pulley Nut
- 11 - Brush Holder End Plate

- 12 - Regulator
- 13 - Spacer
- 14 - Seal
- 15 - Ball Bearing
- 16 - Spacer Washer
- 17 - Bearing Retainer and Screws
- 18 - Washer
- 19 - Ball Bearing
- 20 - Seal
- 21 - Spacer



### Disassembly

- 1 - Remove regulator.
- 2 - Remove pulley and fan.
- 3 - Disconnect field coil terminal from brush holder of the positive brush.
- 4 - Remove both generator through bolts.
- 5 - Disassemble generator frame and withdraw armature.
- 6 - Pull off ball bearings.

After disassembly, thoroughly wash the components in fuel and dry them with compressed air.

### Assembly

This is a reversal of the preceding operations, but the following points should be observed:

- 1 - Inspect armature, field coils, cable connections and brushes.
- 2 - Examine ball bearings for wear and damage. Renew if necessary. Thoroughly rinse the bearings in fuel and fill them with BOSCH High Melting Point Grease.



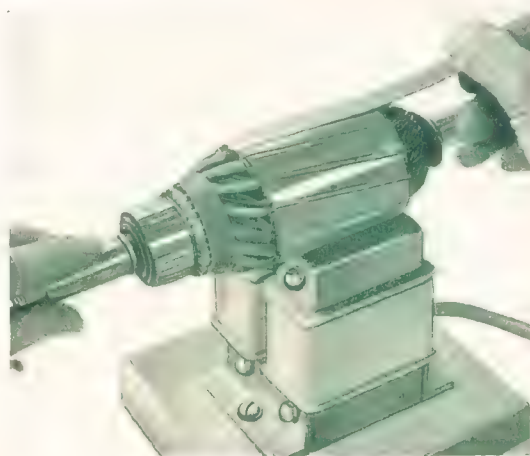
- 3 - Note ball bearing axial play: Too low a play may damage the bearings while too large a play may cause the armature to foul the field coils.
- 4 - See that cables are correctly connected to brush holder and regulator.

## Testing Armature

In a large number of cases the armature does not give visible evidence of trouble. The armature is tested for open circuits, short circuits and ground.

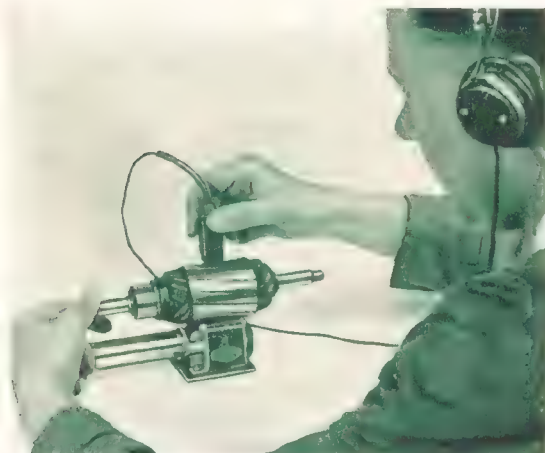
### Test

- 1 - Open circuits in the armature are usually readily apparent, since this condition causes burned spots between the commutator segments due to brush deposit bridging the segments across the inter-segment insulations. Open circuits can also be determined by a sensitive growler, which is, however scarcely available in workshops.
- 2 - A shorted winding can only be tested by means of a growler. Place the armature on the growler, turn the armature slowly and hold a thin steel strip or hacksaw blade over, as shown in the illustration. Short circuits

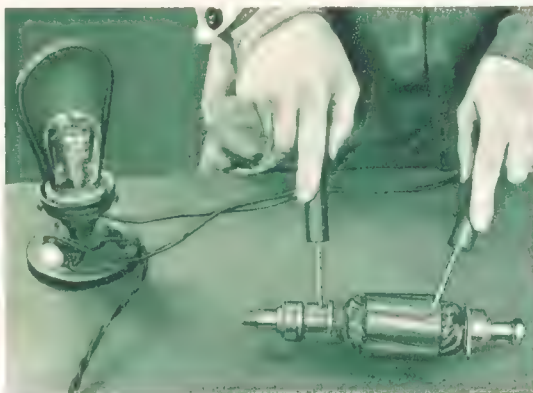


in the armature cause the steel strip or hacksaw blade to vibrate against the core when it is held above the slot containing the shorted winding.

With another type growler the armature is turned, while the mechanic moves a feeler along the armature core. A short circuit in the windings is indicated by a growling noise in the receivers due to alternating current generated in the coil of the feeler by induction.



- 3 - The armature is grounded when the armature core contacts the windings or when carbon dust has entered the windings.



A test is carried out with a test lamp for a line voltage of 220 volts with test points held on commutator and armature core.

## Testing Field Coils

The two field coils are tested for open circuits, short circuits and ground.

### Test

- 1 - Test each field coil individually for open circuits by connecting their ends with a 220-volt test lamp or a battery in series with a 6-volt test lamp.



- 2 - Short circuit in the field windings can be checked by connecting an ohmmeter to the ends of each coil and comparing the readings.

Should such an instrument not be available, connect a 6-volt battery in series with an ammeter to the coil ends and compare the current draw of the two coils. If the current draw of one coil is higher (difference more than 0.5 amperes), there is a short circuit in the windings.

- 3 - Test the field coils for ground by connecting a 220-volt test lamp with the end of one field coil and the frame.



## Generator Trouble Checking

The red generator lamp lights up when the ignition is switched on and should go out when the engine has been started and the speed increases.

| Symptom                                                                | Cause                                                                                                                                                                                                                                                                                                                                           | Remedy                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Generator lamp does not light with ignition switched on                | <ul style="list-style-type: none"> <li>a - Battery discharged</li> <li>b - Battery defective</li> <li>c - Bulb burned out</li> <li>d - Corroded or loose battery terminals</li> <li>e - Loose connections or broken cables</li> <li>f - Ignition switch defective</li> <li>g - Generator brushes do not make contact with commutator</li> </ul> | <ul style="list-style-type: none"> <li>a - Charge battery</li> <li>b - Renew battery</li> <li>c - Renew bulb</li> <li>d - Clean or tighten terminals respectively</li> <li>e - Tighten or repair cables respectively</li> <li>f - Renew ignition switch</li> <li>g - Make the brushes to move freely or renew brushes. If necessary, renew the brush springs</li> </ul> |
| Generator lamp does not go out or flares up when engine is accelerated | <ul style="list-style-type: none"> <li>a - Drive belt loose or faulty</li> <li>b - Regulator faulty</li> <li>c - Charging cables loose or disrupted</li> <li>d - Generator faulty</li> </ul>                                                                                                                                                    | <ul style="list-style-type: none"> <li>a - Adjust belt tension or renew belt</li> <li>b - Renew regulator</li> <li>c - Check cables and connections</li> <li>d - Check generator</li> </ul>                                                                                                                                                                             |
| Generator lamp goes out only at high speed                             | <ul style="list-style-type: none"> <li>a - Generator faulty</li> <li>b - Regulator faulty</li> </ul>                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>a - Check generator</li> <li>b - Renew regulator</li> </ul>                                                                                                                                                                                                                                                                      |
| Generator lamp continues to light with the ignition switched off       | <ul style="list-style-type: none"> <li>a - Regulator contact points sticking (burned)</li> </ul>                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>a - Renew regulator</li> </ul>                                                                                                                                                                                                                                                                                                   |



## General Description

**Type: BOSCH EED 0.4/6 L/4**

The Volkswagen engine is started by a solenoid starting motor of the overrunning-clutch type, producing 0.4 HP. The starting motor draws a heavy current to turn a stiff engine. The drive end of the armature shaft is supported in a bush which is recessed in the transmission case. The starting motor is operated by the ignition key, which causes the solenoid starter switch to shift the pinion (9 teeth) into mesh with the flywheel ring gear (109 teeth). When the solenoid switch closes by the magnetic field, a complete circuit is formed to crank the engine. As soon as the engine fires, the magnetic switch no longer draws current when releasing the ignition key, and the pinion is returned by spring tension. If the starting motor is not immediately switched out when the engine is started, the overrunning clutch prevents the armature from being turned and protects the parts against damage.

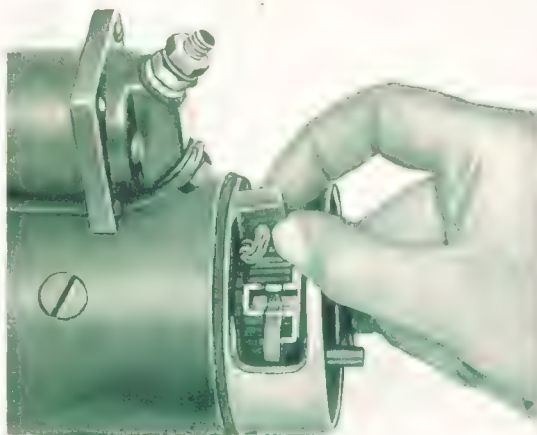
### Note:

From Chassis No. 1 320 559 a new starting motor designated EED 0.5/6 L 4 is used in current production. The new starting motor is equipped with four brushes on the commutator instead of two and has 0.5 hp. The dimensions have remained unchanged. The new starting motor develops a higher cranking speed and is thus more efficient especially in severe frost.

## Maintenance

The armature bearings must only be lubricated when overhauling the starting motor. When removing the engine, the armature bush should be inspected for wear (VW Gauge 246) and renewed if badly worn. The bush is to be filled with Special Grease VW A 051 prior to re-fitting the starting motor.

Every 10.000 km (6.000 miles) take off starting motor end cap, inspect brushes for wear and make sure that they slide freely in their guides. Renew worn brushes and weak brush springs. The commutator must not be oily or gummed. If the commutator is rough and pitted, or shows burned spots, the starting motor must be overhauled. In some cases the commutator can be cleaned by means of a clean cloth dampened with fuel and wrapped around a piece of wood.



## Removing and Installing Starting Motor

### Removal

- 1 - Disconnect positive battery cable at battery.
- 2 - Disconnect battery switch at terminal 30 of the starting motor.
- 3 - Disconnect control cable (to starting button) at terminal 50 of the starting motor.
- 4 - Remove bolt and nuts that attach starting motor to transmission case.
- 5 - Withdraw starting motor.



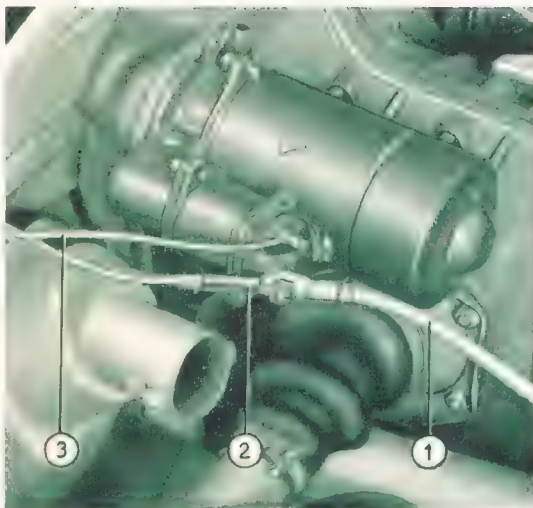
### Installation

This is a reversal of the preceding operations, but the following points should be noted:

- 1 - Lubricate starter shaft bush with Special Grease VW - A 051.
- 2 - Apply VW Sealing Compound D 1 a between intermediate bracket and transmission case.
- 3 - Make sure that the terminals are clean and not loosely connected.

### Connections:

- 1 - Battery (positive terminal).
- 2 - Terminal 51 at generator and terminal 30 at lighting switch.
- 3 - Ignition switch.



## Removing and Installing Solenoid Switch

### Removal

- 1 - Release connector from solenoid switch.



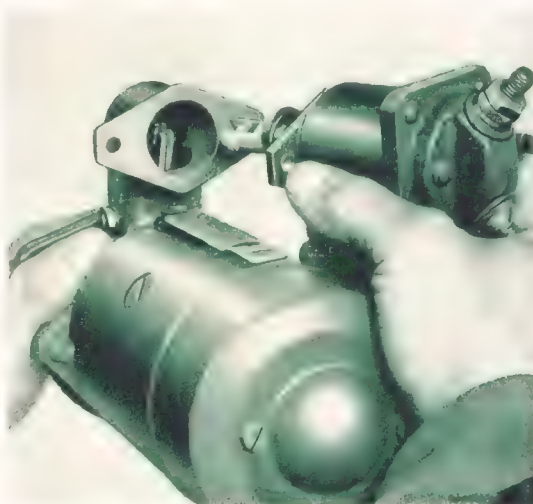
- 2 - Remove screws that attach solenoid switch to intermediate bracket.
- 3 - Slightly withdraw pinion and remove solenoid switch.

Defective solenoid switches must be replaced. Never alter the setting of the switch.

### Installation

This is a reversal of the removal procedure, but attention should be paid to the following points:

- 1 - The contacts of the solenoid switch may have become twisted by using too much force when tightening nuts. This occasionally leads to damage of the insulation. Test them for ground with a 220-volt test lamp.
- 2 - To facilitate connecting solenoid switch with shift lever, slightly pull out starter drive pinion.



## Inspecting Brushes and Commutator

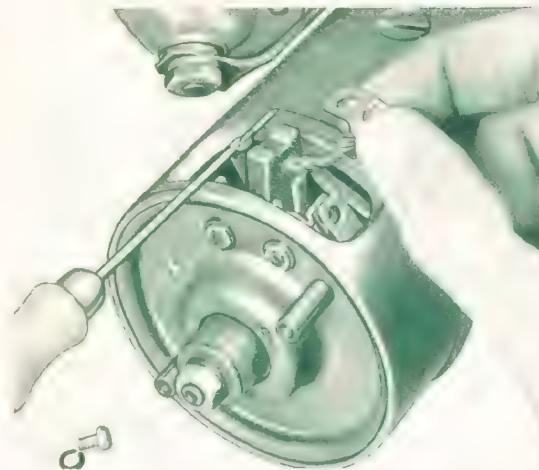
1 - Remove starting motor end cap.

2 - Inspect brushes for wear and make sure that they slide freely in the guide of the brush holders. If the brushes are worn so that they will not bear on the commutator, or if the flexible connector is exposed on the running face, they must be replaced by new ones of the same type. Also replace brushes which are oil-saturated or have loose flexible connectors. When replacing brushes, see that the flexible connector is free to avoid sticking of the brushes during operation.

3 - Test tension of brush springs. Fit a new spring if the tension is low.

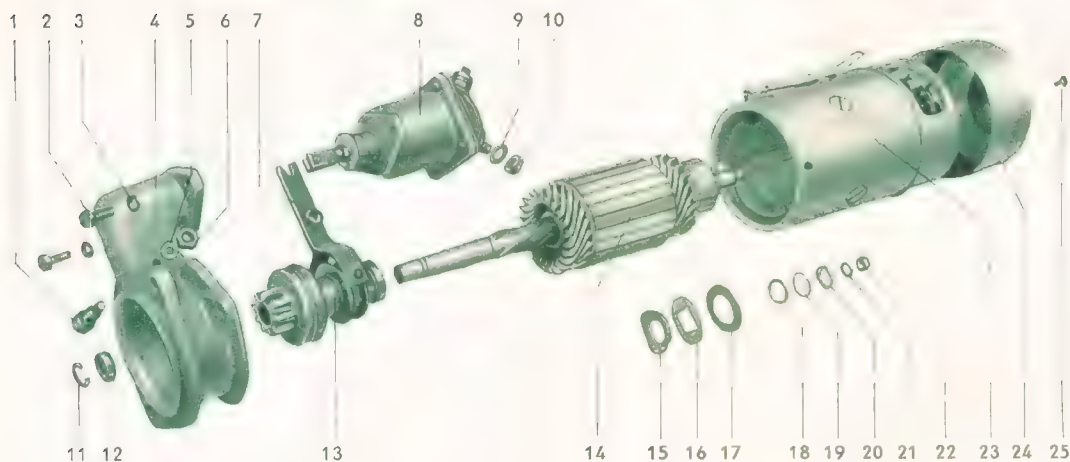
4 - If the commutator is oily or gummed, clean with a cloth dampened with fuel and wrapped around a piece of wood.

Take care that no dirt or fuel enters the bearing.



5 - If the commutator surface is rough and pitted, or shows burned spots, the starting motor should be overhauled.

## Disassembling and Assembling Starting Motor



- 1 - Shift Lever Pivot Screw
- 2 - Bolt
- 3 - Washer
- 4 - Intermediate Bracket
- 5 - Washer
- 6 - Nut
- 7 - Shift Lever
- 8 - Solenoid Switch
- 9 - Lockwasher
- 10 - Nut
- 11 - Circlip
- 12 - Pinion Stop Ring
- 13 - Drive Pinion Assy

- 14 - Armature
- 15 - Lockwasher
- 16 - Retainer Plate
- 17 - Thrust Washer
- 18 - Fiber Washer
- 19 - End Play Washer
- 20 - Cone Washer
- 21 - Lockwasher
- 22 - Nut
- 23 - Frame and Field Assy
- 24 - End Cap
- 25 - Slotted Screw

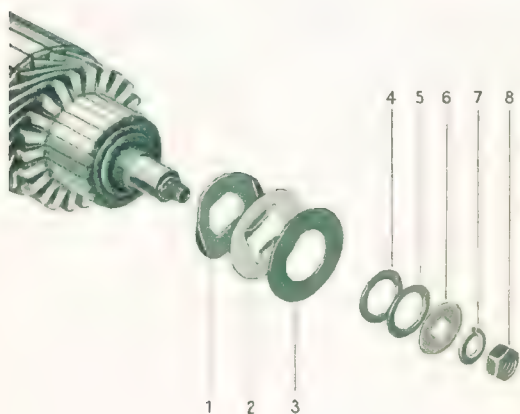


### Disassembly

- 1 - Detach connector from solenoid switch.  
Remove end cap and lift up brushes.
- 2 - Clamp armature shaft at the drive pinion in a vise (use soft jaws) and remove nut at the commutator end of the starting motor.



- 3 - Remove nuts of intermediate bracket hook studs and pull out intermediate bracket with armature. Note arrangement of washers for proper reassembly.



- |                     |   |         |
|---------------------|---|---------|
| 1 - Lockwasher      | } | Inside  |
| 2 - Retainer Plate  |   |         |
| 3 - Thrust Washer   |   |         |
| 4 - Fiber Washer    | } | Outside |
| 5 - End Play Washer |   |         |
| 6 - Cone Washer     |   |         |
| 7 - Lockwasher      |   |         |
| 8 - Nut             |   |         |

- 4 - Place armature in a vise with the commutator end pointing downwards and drive back pinion stop ring by means of a hollow punch.



- 5 - Remove circlip and pull off stop ring. Remove burr which might have developed at circlip groove.
- 6 - Withdraw armature from intermediate bracket and remove drive pinion.

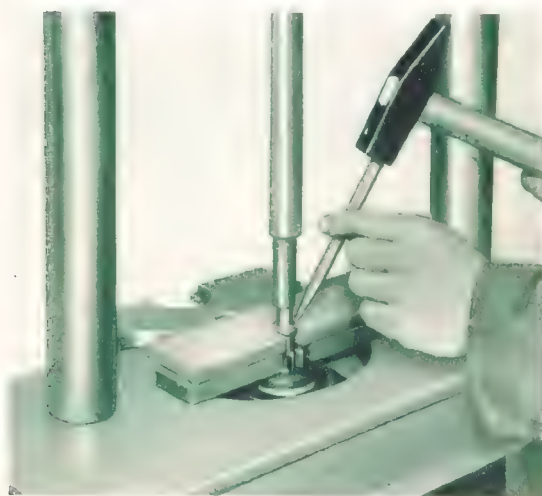


### Assembly

The components are washed in fuel and then dried with compressed air. The compo-bushing of the commutator bearing is only cleaned as far as it is accessible. The drive pinion must only be washed in fuel when it has become oily by leaks and when it is not easily engaging during cold weather. If necessary, renew crankshaft oil seal or main drive shaft oil seal.

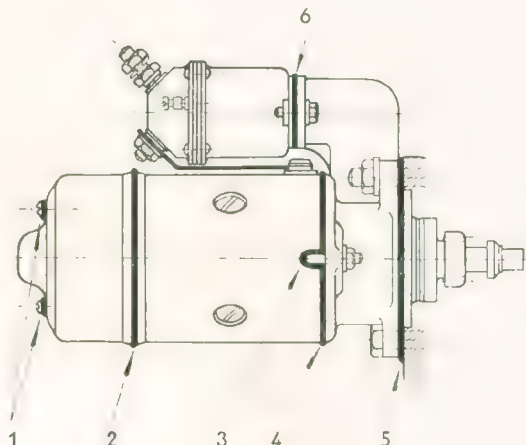
When assembling, the following points should be noted:

- 1 - When replacing bush in commutator bearing, the new bush must be placed in a hot oil bath prior to assembly.
- 2 - Bearing points, armature brake, drive pinion seat, and shift lever should be greased with Universal Grease VW - A 052.
- 3 - The stop ring must be secured in position after installation of circlip by means of a narrow chisel.



- 4 - The armature shaft end play must be within 0.1—0.3 mm (.004"—.012") and can be adjusted by fitting washers.
- 5 - Do not forget to fit end cap rubber seal.

- 6 - To avoid starting trouble caused by water entering the starting motor, the following points should be sealed with VW Sealing Compound D 1 a:



- 1 - Holes for slotted screws in end cap.
- 2 - Rubber seal between frame and end cap.
- 3 - Holes in frame for hook studs of intermediate bracket.
- 4 - Jointing faces of frame and intermediate bracket.
- 5 - Jointing faces of transmission case and intermediate bracket.
- 6 - Jointing faces between solenoid switch and intermediate bracket.

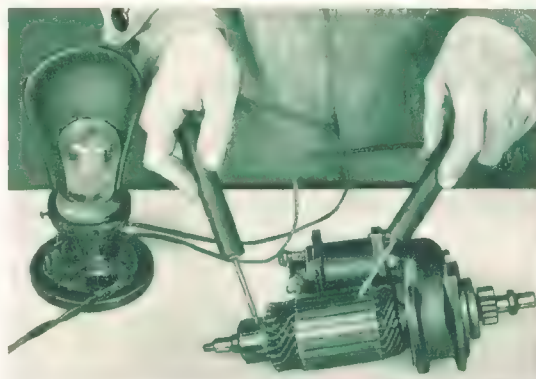
## Testing Armature

In a large number of cases the armature does not give visible evidence of trouble. The armature is tested for open circuits, short circuits and ground.

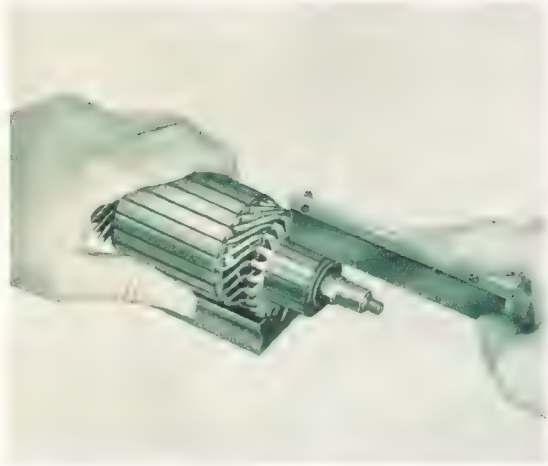
### Test

- 1 - Open circuits in the armature are usually readily apparent, since this condition causes burned spots between the commutator segments due to brush deposits bridging the segments across the intersegment insulations. Check soldered commutator riser-bar connections.
- 2 - The armature is tested for short circuits on the growler. Place the armature on the growler and slowly revolve it while holding a thin steel strip or hacksaw blade above the armature core. Short circuits in the armature cause the steel strip or hacksaw blade to vibrate against the core when it is held above the slot containing shorted winding.
- 3 - The armature is grounded when the armature

core comes into contact with the winding or when carbon dust has entered the windings (direct and indirect ground). The armature is tested electrically for ground while placing one test point of a lamp for a line voltage of 220 volts on the armature core and the other on the commutator.



- 4 - The commutator consists of copper segments and mica. If the commutator is out of round and roughened by burned spots, or if it is grooved, it should be turned in a lathe to obtain a smooth surface. Do not remove more metal than is necessary. Then, the mica should be undercut 0.1—0.2 mm (.004"—.008"). This operation may be done with a ground-down hacksaw blade or, if available, with a motor-driven undercutter. Make sure no metal chips remain between the segments, as these may lead to short circuits.



## Testing Field Coils

The two field coils are tested for open circuits, short circuits and ground.

### Test

- 1 - The field coils can be tested for an open circuit by connecting a 6-volt battery in series with a test lamp and placing the points at the ends of each coil.
- 2 - If the outer insulation of the field coils is found to be in order, there is rarely a short circuit
- 3 - Test for a grounded field with points of a 220-volt test lamp on one coil end and frame.
- 4 - Also make sure that the electrical connections between the two field coils are in order.

in the windings. To determine short circuits is generally beyond the scope of a workshop, as this requires special appliances.

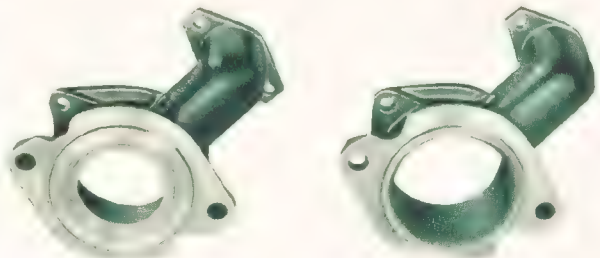
## Starting Motor

(Sealed)

With effect from Chassis No. 1 517 414 a new starting motor with the designation EED 0.5/6 L 34/1, (Part. No. 111 911 021 B) is installed.

The starting motor drive pinion assembly has additionally been provided with a thrust collar which, with the motor at rest, comes to rest on the altered intermediate bracket. The width of the rear guide ring has been decreased in this connection.

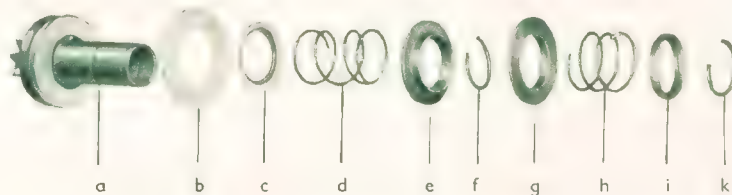
The stop ring on the armature shaft which provided a limitation for the pinion in starting motors of previous design has been omitted. The limitation is now provided by the thrust collar. Armatures of new design cannot be installed in earlier starting motors because of the absence of the stop ring.





The purpose of this modification is to prevent ingress of moisture and dirt into the starting motor.

**new type:**



**earlier type:**



a - Pinion  
b - Thrust Collar  
c - Spring Seat  
d - Helical Spring

e - Guide Ring  
f - Snap Ring  
g - Guide Ring  
h - Helical Spring

i - Spacer  
k - Snap Ring  
l - Stop Ring

To convert earlier starting motors into sealed ones proceed as follows:

**Parts required:**

|                        |                        |
|------------------------|------------------------|
| 1 Cover Plate          | Part No. 111 911 351   |
| 1 Spring Seat          | Part No. 111 911 349   |
| 1 Guide Ring, rear     | Part No. 111 911 343 A |
| 1 Intermediate Bracket | Part No. 111 911 255 A |
| 1 Armature             | Part No. 111 911 311 A |

- 1 - Remove starting motor.
- 2 - Remove solenoid switch.
- 3 - Remove intermediate bracket and take out pinion assy. Replace the intermediate bracket by one of new design.

4 - Remove armature and replace by a new one.

5 - Remove rear snap ring from pinion assy.

6 - Remove spacer and helical spring.

7 - Remove rear guide ring and replace by ring of new design.

8 - Remove snap ring.

9 - Remove front guide ring and helical spring.

10 - Remove stop ring.

**Assembly:**

Put thrust collar and spring seat on the protective cap of the overrunning clutch and assemble starting motor.

## Starting Motor Trouble Checking

| Symptom                                                                                                                  | Cause                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Remedy                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Starter does not operate when pressing button                                                                            | <p>Switch on the lamps when testing:</p> <p>a - <b>Lights do not burn.</b> Loose cables or poor ground connection. Battery run down</p> <p>b - <b>Lights go out when operating the starter.</b> Insufficient current due to loose connections or corroded terminals</p> <p>c - <b>Lights go dim when operating the starter.</b> Battery run down</p> <p>d - <b>Lights stay bright when operating the starter.</b> Make a jumper contact between terminals 30 and 50 at starting motor: If the starting motor operates, there is an open circuit in cable 50 to ignition switch, or in cable 30 to lighting switch, or the ignition switch is defective</p> <p>e - <b>Lights stay bright and plunger in solenoid switch is pulled when operating the starter.</b> Disconnect battery cable from terminal 30 at starting motor and connect it to terminal stud of connector (contact blade). If the starting motor operates, the contacts of the solenoid switch are worn or dirty</p> | <p>a - Check battery cables and connections. Test voltage of battery</p> <p>b - Clean battery terminals and cable clamps, clean and tighten connections between battery, starting motor and ground</p> <p>c - Charge battery</p> <p>d - Eliminate open circuits, replace defective parts</p> <p>e - Replace solenoid switch</p> |
| Starting motor does not operate when battery cable is directly connected with terminal stud of connector (contact) blade | <p>a - Brushes sticking</p> <p>b - Brushes worn</p> <p>c - Weak spring tension. Brushes do not make contact</p> <p>d - Commutator dirty</p> <p>e - Commutator rough, pitted, or burned</p> <p>f - Armature or field coils defective</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>a - Clean brushes and guides of brush holders</p> <p>b - Replace brushes</p> <p>c - Replace springs</p> <p>d - Clean commutator</p> <p>e - Recondition starting motor</p> <p>f - Overhaul starting motor</p>                                                                                                                 |
| Sluggish or slow action of the starting motor                                                                            | <p>a - Battery run down</p> <p>b - Insufficient current flow due to loose or corroded connections</p> <p>c - Brushes sticking</p> <p>d - Brushes worn</p> <p>e - Commutator dirty</p> <p>f - Commutator rough, pitted, or burned</p> <p>g - Armature or field coils defective</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>a - Charge battery</p> <p>b - Clean battery terminals and cable clamps, tighten connections</p> <p>c - Clean brushes and guides of brush holders</p> <p>d - Replace brushes</p> <p>e - Clean commutator</p> <p>f - Recondition starting motor</p> <p>g - Overhaul starting motor</p>                                         |
| Starting motor is heard to operate, but cranks engine erratically or not at all                                          | <p>a - Drive pinion defective</p> <p>b - Flywheel gear ring defective</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>a - Replace drive pinion</p> <p>b - Replace flywheel or remachine gear ring</p>                                                                                                                                                                                                                                              |
| Drive pinion does not move out of mesh                                                                                   | <p>a - Drive pinion or armature shaft dirty or damaged</p> <p>b - Solenoid switch defective</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>a - Overhaul starting motor</p> <p>b - Replace solenoid switch</p>                                                                                                                                                                                                                                                           |

## General Description

### Type: 6 volts, 70 amp.-hours

The battery stores the energy produced by the generator and supplies current for operating starting motor, lights, and other electrical accessories. It consists of three cells, each of which has a positive lead peroxide plate group ( $\text{PbO}_2$ ) and a negative sponge lead plate group ( $\text{Pb}$ ). The electrolyte is made up of about 40 per cent sulphuric acid and about 60 per cent water ( $\text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ ) having a specific gravity of  $1.285 = 32^\circ \text{Bé}$  (Baumé).

The cells are united in the battery case and connected electrically by lead cell connectors. To avoid confusion, the positive battery terminal post is made thicker than the negative terminal post.

### Cell voltage

The average voltage of each cell is 2 volts. It increases to about 2.5—2.7 volts with the battery being charged and decreases to between 2.1 and 2.0 volts soon after the charging current has been cut out. The battery is discharged when the cell voltage has dropped to 1.75—1.8 volts under no-load conditions.

### Battery Rating

The discharging rate of the battery amounts to 70 ampere-hours. The 20-hour rate represents the amount of current a battery can deliver for 20 hours at a temperature of  $20^\circ \text{C}$  ( $70^\circ \text{F}$ ). Thus, a battery of 70 ampere-hours can deliver a current of 3.5 amperes for 20 hours at a temperature of  $20^\circ \text{C}$  ( $70^\circ \text{F}$ ).

### Chemical Activities in Battery:

#### Discharging

The sponge lead (negative plate) and lead peroxide (positive plate) change to lead sulphate ( $\text{PbSO}_4$ ) during the discharge process. The sulphate comes from the sulphuric acid; the electrolyte loses acid and gains water, thus the specific gravity decreases.

#### Charging

The direct current from the generator causes the lead sulphate to change back to sponge lead in the negative plates and lead peroxide in the positive plates, and the sulphuric acid reappears in the electrolyte, increasing the specific gravity of the electrolyte. If the charging current is not cut off in time, hydrogen and oxygen gases are generated in the cell and the battery commences to "boil".

## Battery Maintenance

Ready starting of the engine depends upon perfect condition of the battery. It should, therefore, be inspected at regular intervals.

### Hydrometer Test

The state of charge of the battery may be checked by means of a battery hydrometer. The specific gravity of the battery liquid will increase with the charging of the battery. Tested with the hydrometer, the gravity can be read from the scale of a float.

Battery fully discharged  $18^\circ \text{Bé} = \text{spec. gravity } 1.142$

Battery semi-charged  $27^\circ \text{Bé} = \text{spec. gravity } 1.230$

Battery fully charged  $32^\circ \text{Bé} = \text{spec. gravity } 1.285$





### Electrolyte Level

During operation, the electrolyte level in the battery drops due to loss of water. Only distilled water should be added, as other water has chemical properties which are harmful to the electrolyte. The electrolyte level should be approximately 15 mm (.60") above the plates. Never add acid, unless it is known that acid has been spilled from the battery. Check specific gravity afterwards and compensate if necessary.



#### Note:

The standard level of the battery acid has been lowered with effect from May 1958.

The acid should reach up to 5 mm =  $13/64$ " (formerly 10—15 mm =  $25/64$ — $19/32$ ") above the top edges of the battery plates (separators) or to about just above the splash plate, if any. If there is an acid level mark, the acid level has to be adjusted accordingly.

During prolonged periods of operation in day-time or when fully charged, batteries may tend to "boil over" if the acid level is too high.

### Voltage Test

The high-discharge test is carried out by an individual cell tester consisting of a low-reading voltmeter and a heavy resistance of between 80—100 amperes.

The two prods of this instrument are placed across the terminal posts of each battery cell in turn. The voltage of each cell should not fall below 1.6 volts while the reading is being taken (10 to 15 seconds). Otherwise the cell is discharged or defective. The

normal voltage is 2 volts. The difference between the cells should not be in excess of 0.2 volt.



### How to Maintain Battery

Because of the high stress imposed on the battery when starting, the average service life of a battery amounts to two years. The battery is subjected to an especially heavy strain by continuously trying to start when the engine does not fire at once, since a current of up to 250 amperes is drawn from the battery when starting.

The battery must be held firmly in its mounting. Terminal posts and cable clamps should be kept free from corrosion to prevent excessive electrical resistance. They should be cleaned with a clean rag, or, in severe cases, with some battery pole cleaner. Then coat the posts and cable clamps with vaseline or petroleum jelly to prevent corrosion. Cable clamps which are difficult to remove from the terminal posts due to corrosion should be removed with a special tool designed for this purpose.

Since some spraying of battery electrolyte is natural as the battery is being charged, traces of electrolyte should be cleaned off by use of a wire brush and common baking soda solution to avoid damage to the fabric and metal parts.

### Recharging Battery

It is good practice to remove the battery at intervals of three or four months and discharge it down to a cell voltage of 1.8 volts before recharging it. Batteries are subject to a selfdischarge of 1 per cent per day with the battery in good condition. If the car is left stationary for a longer period, the battery must be recharged at 7-week intervals.

The current input depends on the capacity of the battery and should, with a battery of 70 amp. hours, not exceed the rate of 7.0 amperes. Thus, the charging requires about 10 hours or more at a lower charging rate. The fully charged condition is reached when the cell voltage has increased to

approx. 2.5—2.7 volts, the battery is gassing freely and there is no further rise in voltage for three hours. This should be checked at intervals of 1 hour.

Before charging, the vent plugs should be removed.

## Charging New Batteries

New batteries are generally received in an uncharged condition. When charging, the manufacturer's instructions should be followed, however, some general hints are given below:

- 1 - Remove vent plugs and fill cells with chemically pure battery acid diluted with distilled water to a specific gravity of 1.285 at 20° C (70° F). The level should be approx. 15 mm (.60") above the plates.
- 2 - Let the battery stand for 5 or 6 hours to allow the plates to be saturated with electrolyte. The electrolyte level drops slightly during this period.
- 3 - Add electrolyte to restore correct level.
- 4 - Charge battery at a rate of 5 amperes until the

voltage of each cell is between 2.5 and 2.7 volts and all cells gas freely.

- 5 - The maximum permissible temperature of electrolyte during external charging is 40° C (105° F) and if this is reached, the charge should be suspended to allow the temperature to fall.
- 6 - After charging, check specific gravity (1.285 = 32° Baumé) and adjust it if necessary. Should an adding of acid or distilled water become necessary, the battery must be recharged for a short time to insure a good mixing of the fluid.
- 7 - The vent plugs must be replaced not earlier than two hours after the charging, if possible still later. Wash off spilled electrolyte and then dry battery.

## Cold Operation

It is true that the conductivity and degree of viscosity of the electrolyte largely depends on temperature conditions. Extreme cold considerably reduces battery output. At an electrolyte temperature of -15° C (5° F), the output amounts to only 50 per cent of that at a temperature of +20° C (70° F).

The higher the gravity of the electrolyte, the lower its temperature must be before it will freeze. The battery must, therefore, be kept in a sufficiently charged condition to prevent its freezing. If the freezing has not ruined the battery, working conditions can be restored by thawing out and recharging the battery.

| Spec. Gravity | Freezing Temperature |
|---------------|----------------------|
| 1.285         | -65° C (-85° F)      |
| 1.18          | -22.5° C (-8° F)     |
| 1.14          | -13° C (9° F)        |

The increased stress imposed on the battery by the starting motor at low temperatures, which has to crank the stiff engine, necessitates a more frequent inspection of the battery. In winter, it is recommended to remove the battery at 4-week intervals for recharging and checking specific gravity and electrolyte level.

**Caution!** Keep any open flame away from the room where batteries are charged. It is advisable not to have precision tools and instruments in such rooms.

### Note:

From Chassis No. 1 - 0 931 501 approx. a new battery of reduced height has been installed. The clamping strap has been altered accordingly. The capacity amounts to 66 amp. hours. The cold start performance of the battery has gone up by 50 per cent. on account of the increased number of plates.

The new battery can be used on earlier cars only in connection with the new lid and the shorter clamping strap.

## Karmann Ghia Models

### Battery Ground Strap

With effect from Chassis No. 1 304 939 the length of the battery ground strap on the Karmann Ghia has been increased from 240 mm (9.45") to 360 mm (14.17"). The new strap (Part No. 141 971 235) runs from the battery direct to the engine where it is fastened with the fillister-head screw below the oil filler cap.

Hitherto the ground strap was fastened to the engine compartment floor. The modification is to reduce the voltage drop.



## General Description

The ignition equipment consists of the battery, switch, ignition coil, ignition distributor with centrifugal advance mechanism, spark plugs and wiring. The low tension current, supplied by the battery, is converted to high tension current by the ignition coil.

## Ignition Coil

### General Description

**Type: Bosch TK 6/3**

The ignition coil consists of an iron core around which are a primary circuit made up of a winding of a few hundred turns of heavy wire and a secondary circuit made up of a winding of many thousands of turns of a fine wire. The process in the ignition coil is similar to that of a transformer. As the contact points separate in the distributor, the flow of current from the battery through the primary winding of the coil is interrupted and the magnetic field collapses. The collapsing magnetic field induces high-voltage surge that is conducted through the distributor rotor and cap to a spark plug. A condenser is connected in parallel with the contact breaker to prevent a heavy electric arc to take place across the separating contact points, because it momentarily provides a place for the current to flow as the points begin to move apart.

### Maintenance

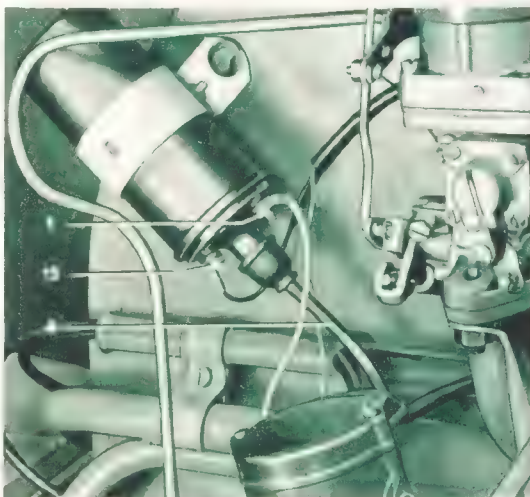
The coil insulating cap must be kept clean and dry to prevent high-tension leakage across the cap.

### Inspection

To test the ignition coil for serviceability, the length of the spark produced by it should be measured. This can be done on a test bench or on the engine.

If, after an inspection, the supply of current and the distributor are considered in good order, disconnect lead 4 at distributor and hold it about 7 mm (.03") from the crankcase.

If no spark occurs while cranking the engine, the ignition coil must be replaced.



### Connections:

- Terminal 1 to distributor (contact breaker)
- Terminal 15 to ignition switch
- Terminal 4 to distributor cap (high-tension lead)

## Distributor

### General Description

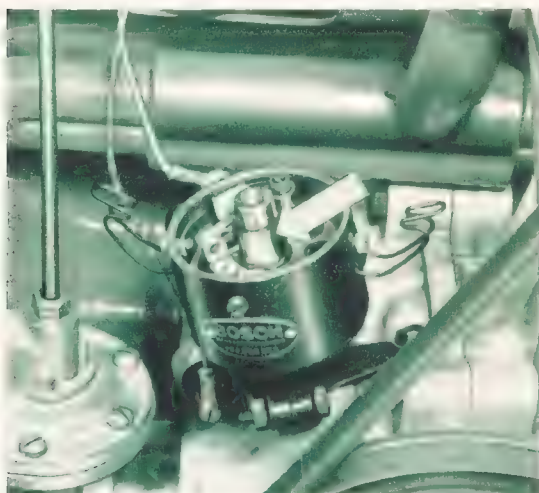
**Type: BOSCH VE 4 BRS 383**

The distributor serves the purpose of distributing the high voltage current to the spark plugs in proper time. Timing of the distributor point opening is controlled by manual setting and a centrifugal spark-advance mechanism.

### Maintenance

Dirty or slightly burned breaker points should be cleaned up by the use of a point file, which is made especially for this purpose. Emery cloth should not be used. The contacting surfaces must be flat and even to insure a parallel contact. To obtain this, the moving point must be slightly pressed against the fixed point while moving the file between them.

Clean the interior of the distributor with compressed air. The cam lobes should be slightly greased with Universal Grease VW - A 052 to reduce wear of the fiber block to a minimum.



It is recommended to add a few drops of engine oil down the shaft through the contact breaker plate when carrying out the first service inspection of the car, but care should be taken that no oil comes into contact with the breaker points.

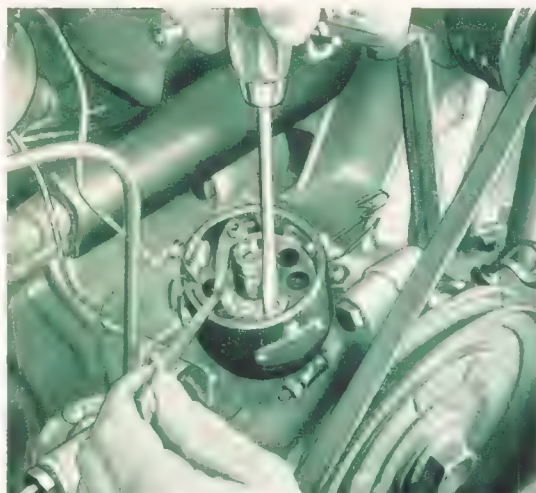
The rotor finger and the four segments of the distributor cap are subjected to a certain amount of wear because of the sparks continuously occurring during operation. Troubles may occur, if the insulating material of the distributor cap or the rotor is cracked. The cap must be kept clean and dry inside and out to avoid high-tension leakages and short circuits. When mounting the cap, make sure that the spring-loaded brush for the rotor is fitted.

### Adjusting Breaker Points

To adjust the breaker points proceed as follows:

- 1 - Remove distributor cap and rotor.
- 2 - Crank the engine until the fiber block on the breaker arm rests on the highest point of the cam lobe.
- 3 - Loosen the lock screw of the fixed breaker point.

- 4 - Turn the eccentric adjusting screw until the correct gap of 0.4 mm (0.016") is obtained. Check with a feeler gauge.



- 5 - Tighten lock screw.

- 6 - Recheck the gap.

#### Important!

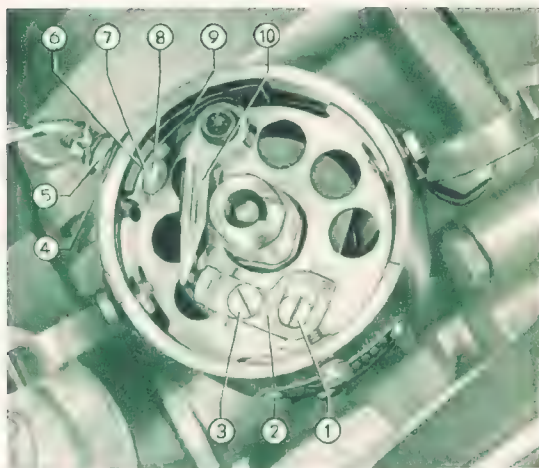
After the contact points have been adjusted it is absolutely necessary to readjust the ignition timing, as a change of 0.1 mm (0.004") in the amount of gap changes the ignition timing by about 3° of the crankshaft angle.

A correct opening and closing of the breaker points is only insured, if there is no radial play in the distributor shaft and bearings.

### Replacing Breaker Points

The breaker points naturally wear during service by burning. If the point has been reached where an adjustment is no longer possible, or if the breaker points are badly burned, install a new set:

- 1 - Remove distributor cap.
- 2 - Disconnect low-tension cable from terminal 1 at distributor.
- 3 - Loosen nut of terminal screw and lift off breaker arm.



- |                                   |                             |
|-----------------------------------|-----------------------------|
| 1 - Breaker point adjusting screw | 5 - Primary lead connection |
| 2 - Breaker point                 | 6 - Insulation piece        |
| 3 - Breaker point lock screw      | 7 - Angle plate             |
| 4 - Insulating washer             | 8 - Terminal screw          |
|                                   | 9 - Insulation              |
|                                   | 10 - Breaker arm            |

When fitting the new breaker arm, note proper position of insulation to avoid short circuit at this point.

- 4 - Connect low-tension cable.
- 5 - Replace fixed breaker point after having removed the lock screw.
- 6 - Readjust breaker point gap. Refit rotor and distributor cap.

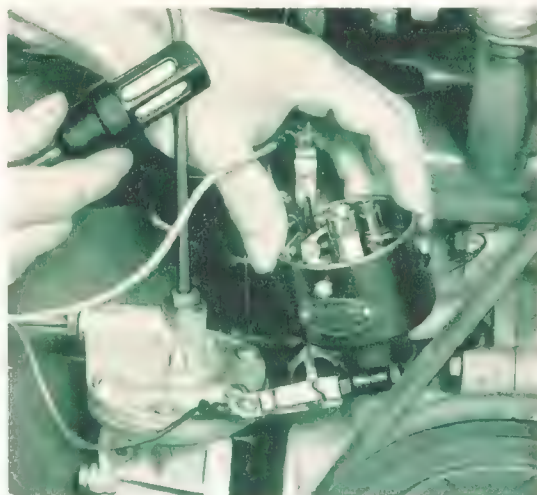
### Ignition Timing

Before timing the ignition to  $5^\circ$  before top dead center, the breaker points must be checked.

- 1 - Crank the engine until the mark of the crankshaft pulley lines up with the vertical crankcase jointing faces and the distributor rotor arm is in the position for firing on the No. 1 cylinder (see mark on rim of distributor base).
- 2 - Loosen clamp screw of distributor retainer.
- 3 - Connect one lead of 6-volt test lamp to terminal 1 at distributor and the other to ground.

- 4 - Switch on ignition.

- 5 - Rotate the distributor body clockwise until the contact points are closed and then slowly counter-clockwise until the breaker points just mark to open and the test lamp lights up.



- 6 - Tighten clamp screw of distributor retainer.

- 7 - Refit rotor and distributor cap.

The ignition is correctly timed for all four cylinders, if the lamp lights up when the mark on the pulley is exactly in its highest or lowest position (in line with the crankcase jointing faces) while slowly cranking the engine.

### Centrifugal Advance Mechanism

The centrifugal mechanism consists of two weights that throw out against spring tension. This movement is transmitted through a toggle arrangement to the breaker cam, causing it to advance or move ahead with respect to the distributor drive shaft as engine speed increases (max.  $30^\circ$ ).

### Testing Centrifugal Advance Mechanism

The effect of the advance mechanism can be checked by turning the mounted rotor clockwise

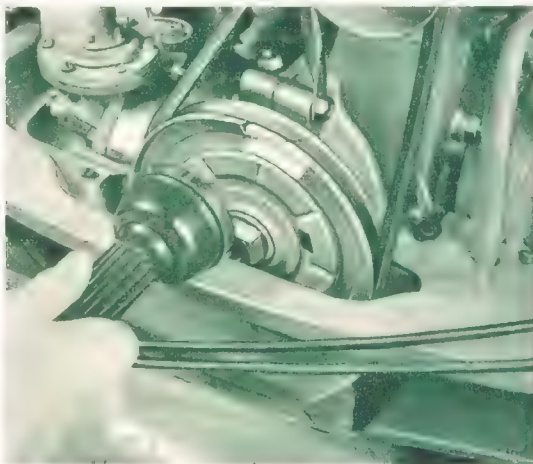
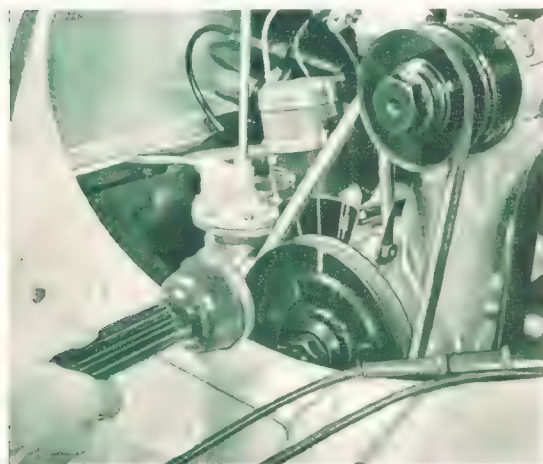


up to the stop. The rotor must move back to its original position, that is, to the opposite stop when it is released. Otherwise the advance mechanism is dirty or the spring tension is incorrect. A "pinking" noise in the engine, which seems to be inexplicable, is occasionally caused by a defective advance mechanism. The ignition timing indicator VW 342 enables the mechanic to carry out a precise checking of the advance mechanism in a simple way.

A control scale (drawing No. 373 for local production), specially designed for the VW engine, is attached to the crankcase and shows in connection with the ignition timing light the setting of the ignition and the action of the centrifugal advance mechanism. A faulty setting, or mechanical troubles, evidenced by a too advanced, retarded, or uneven ignition timing, can easily be detected.

- 2 - Draw a line 2—3 mm (0.08"—0.11") thick at the ignition timing mark on the fan pulley with chalk or paint.
- 3 - Connect one lead of the timing light to the spark plug of cylinder No. 1 and the other lead to the disconnected spark plug cable (series connection).
- 4 - Start engine. — Hold timing light close to pulley and scale. The distributor functions properly, if the white line on the pulley is steadily (not jerkily) moving within that field of the scale corresponding to the speed of the engine.

If the timing light is used without the scale, a white line 10 mm (2.5") thick should be drawn along the circumference of the pulley from the ignition timing mark 47 mm (1.85") in clockwise direction (see fig. below).



#### Application:

- 1 - Attach control scale to distributor mounting stud so that the scale slot is in line with the vertical crankcase jointing faces.

At idling speed, the left end of the line should approx. line up with the crankcase jointing faces and the right end should approx. line up with them at to speed.

| White Line at: | Speed                 | Advanced Ignition |
|----------------|-----------------------|-------------------|
| Scale Slot     | Standstill            | 5°                |
| 1st Scale Line | Approx. 600 R. P. M.  | Approx. 5°—9°     |
| 2nd Scale Line | Approx. 1400 R. P. M. | Approx. 15°—20°   |
| 3rd Scale Line | Approx. 2800 R. P. M. | Approx. 32°—37°   |

### Testing Condenser

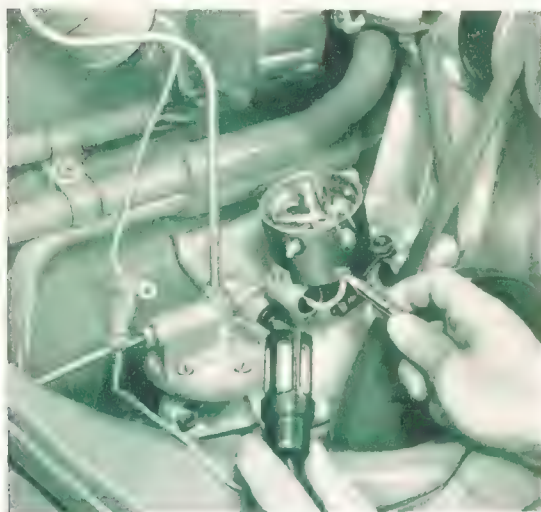
The condenser is very important to obtain the required high voltage for the ignition. It also reduces the spark occurring between the points when they separate to prevent a premature burning of the points.

A defective condenser is indicated by burned breaker points and weak spark in connection with difficult starting, or failure of the engine to start.

### Test

Modern testing equipment checks a condenser for high resistance, insulation leakage, and capacity. If condenser testing equipment is not available, proceed as follows:

- 1 - Disconnect cable 1 and condenser cable at terminal of breaker arm.
- 2 - Connect the one lead of a 6-volt test lamp to terminal 1 at ignition coil and the other to the condenser cable.



- 3 - Switch on ignition. If the test lamp lights up, the condenser is grounded and should be replaced.
- 4 - Connect cable 1 and condenser cable.
- 5 - Disconnect high tension lead 4 at distributor cap and hold it approx.  $\frac{1}{4}$  inch from the crankcase or other suitable ground.

- 6 - Crank engine with ignition switched on. If no spark occurs at the prescribed distance, the check should be repeated with a new condenser.

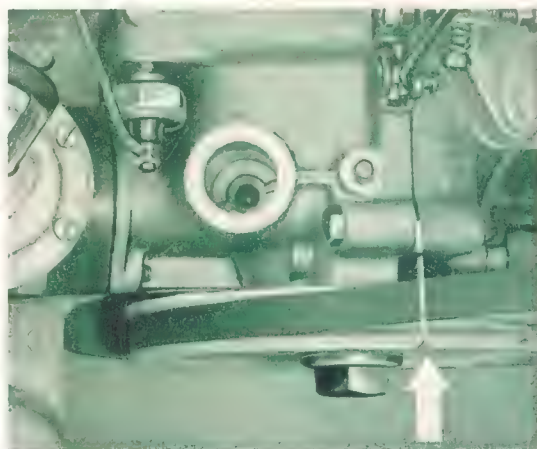
Only use condensers of the prescribed type: ZKO 29/6 2 Z, as condensers of incorrect capacities will seriously affect breaker point life.

### Removing and Installing Distributor

- 1 - Disconnect cable from terminal 1 at distributor (loosen breaker point terminal screw).
- 2 - Take off distributor cap.
- 3 - Loosen nut of distributor retainer.
- 4 - Lift off distributor.

Installing the distributor is done in the reverse order, but the following points should be noted:

- 1 - Crank the engine until it is in the position for firing on the No. 1 cylinder. The slot of the distributor drive pinion must then be offset towards the rear and nearly parallel to the fan pulley, while the fan pulley mark is in line with the crankcase jointing faces.



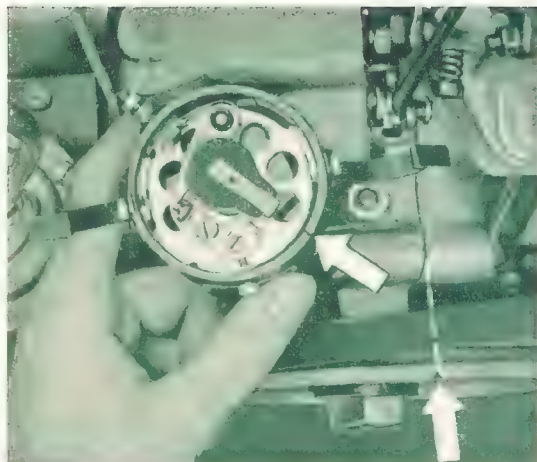
- 2 - Make sure the distance spring is properly seated in the distributor drive pinion head.
- 3 - When installing distributor, turn distributor shaft until the finger of the rotor points to the mark for cylinder No. 1 on the base rim and

the shaft end enters the slot in the distributor drive pinion.  
4 - Time the ignition.

**Note:**

All 1131 c. c. engines were equipped with the ignition distributor BOSCH VE 4 BRS 383 at the factory. This distributor is interchangeable with the distributor BOSCH VJ 4 BR 8; however, the basic advance adjustment must be altered as indicated below when using the latter distributor:

| 1131 c. c. Engine, 25 b. hp. with compression ratio of 5.6:1 |                       |                                                     |
|--------------------------------------------------------------|-----------------------|-----------------------------------------------------|
| Ignition Distributor                                         | Ignition Timing       | Timing Mark                                         |
| VE 4 BRS 383                                                 | 5° before T. D. C.    | In line with crankcase jointing faces               |
| VJ 4 BR 8                                                    | 12.5° before T. D. C. | 12 mm (.5") to the left of crankcase jointing faces |



## Spark Plugs

| Types     | 1131 c.c.    | 1192 c.c.     |
|-----------|--------------|---------------|
| Bosch     | W 175 T 1    | W 225 T 1     |
| Beru      | K 175/14 U 2 | 225/14 U 2    |
| Lodge     | H 14         | H 14 or HN    |
| Champion  | L 10 S       | L 10 S        |
| AC        | 45 L         | 43 L          |
| Auto-Life | —            | AE 6 or AER 6 |
| KLK       | —            | F 70          |

Spark plug thread = 14 mm (.551")

The electric spark jumps the gap between the two electrodes to ignite the fuel-air mixture in the combustion chamber. Never use plugs of other types than mentioned above, as starting, idling, acceleration and max. performance greatly depend on the right choice of the spark plug. The heat range of the correct plug can be ascertained from the above table.

### Maintenance and Inspection

Spark plugs should be cleaned and the gaps checked at 5000 km (3000 miles) intervals.

To an experienced and skilled mechanic, the appearance of the spark plug gives evidence of the adjustment and engine operation condition. The following rules are generally applicable:

a = 0.6—0.7 mm (.024"—.027")

### Electrodes and insulator

- fawn — good carburetor setting and correct performance of spark plug;
- black — mixture too rich;
- lightgrey — mixture too lean;
- oiled up — failure of spark plug or worn out cylinder.

In the case of fuel containing lead-tetra-ethyl (anti-knock fuel), the insulator will show a grey colour, provided the engine is correctly adjusted.

During operation, the plug gap increases due to natural burning. If the gap has increased too much, the plug may fail to operate. The gap is checked by means of a gauge and adjusted by bending the ground (outer) electrode to the correct value (0.6—0.7 mm = .024"—.027").



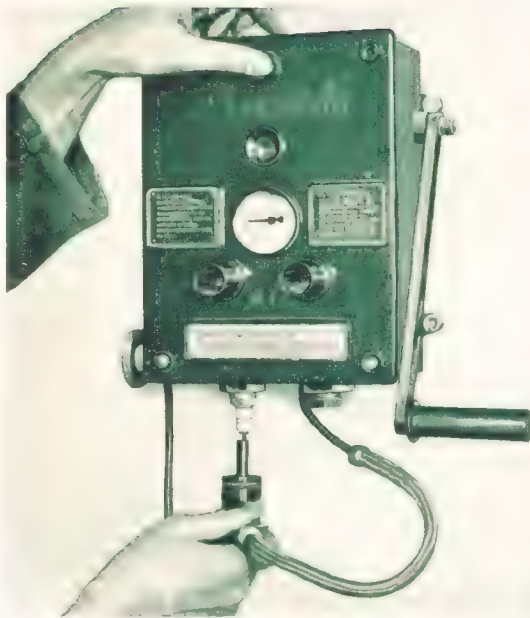


A number of testing devices for spark plugs are in use, where the spark must occur under pressure (6—7 atm. = 85—100 lbs./sq. in.) and can be watched through an inspection hole.

When installing spark plugs, make sure the gaskets are not forgotten. For peak engine performance, it is recommended to replace spark plugs every 15.000 km (9.500 miles).

Dirty spark plugs are cleaned with a brush and a chip of wood. Oiled-up spark plugs are made serviceable by burning them dry. The insulator must be kept clean and dry to avoid short circuits and high-tension leakage. A sand-blast type cleaner should be used for cleaning spark plugs, if available.

If vehicles are mainly driven in city traffic and over short distances during the cold season, the spark plug gaps should be decreased from 0.6—0.7 mm (.024"—.027") to 0.4—0.5 mm (.016"—.020").



## General Description

The ignition equipment consists of the battery, ignition coil, and ignition distributor with centrifugal advance mechanism. The additional advance obtained by the vacuum mechanism is to improve operating smoothness and fuel economy under part-throttle conditions. The low tension current, supplied by the 6-volt battery, is converted to high tension current by the ignition coil.

## Ignition Coil

### General

#### Type: Bosch TE 6 A 3

The ignition coil consists of an iron core around which are a primary circuit made up of a winding of a few hundred turns of heavy wire and a secondary circuit made up of a winding of many thousands of turns of a fine wire. The process in the ignition coil is similar to that of a transformer. As the contact points separate in the distributor, the flow of current from the battery through the primary winding of the coil is interrupted and the magnetic field collapses. The collapsing magnetic field induces high-voltage surge that is conducted through the distributor rotor and cap to a spark plug. A condenser is connected in parallel with the contact breaker to prevent a heavy electric arc from taking place across the separating contact points, because it momentarily provides a place for the current to flow as the points begin to move apart.

### Maintenance

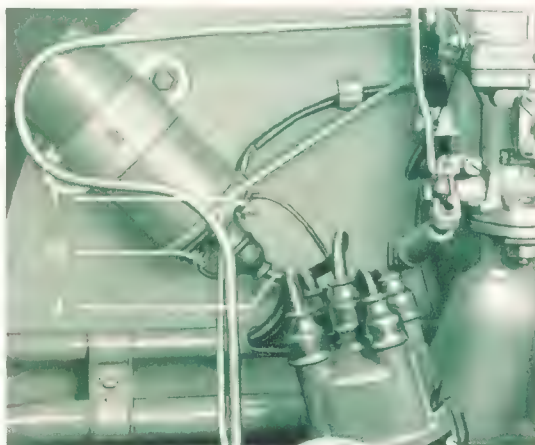
The coil insulating cap must be kept clean and dry to prevent high-tension leakage across the cap.

### Inspection

To test the ignition coil for serviceability, the length of the spark produced by it should be measured. This can be done on a test bench or on the engine. If, after an inspection, the supply of current and the distributor are considered in good order, disconnect

lead 4 at distributor and hold it about 7 mm (.3") from the crankcase.

If no spark occurs while cranking the engine, the ignition coil must be replaced, provided that the condenser has been found to be in perfect order.



### Connections:

- Terminal 1 to distributor (contact breaker)
- Terminal 15 to ignition switch
- Terminal 4 to distributor cap (high-tension lead)

### Note:

From Chassis No. 1 261 493 a new type ignition coil, designated TE 6 B 1, is used on all new production cars. This coil has a higher output, thus offering safer engine operation under extreme conditions of load.

The two types of ignition coil are interchangeable.

## Distributor

### General

#### Type: BOSCH V JU 4 BR 3 mk

The distributor serves the purposes of distributing the high voltage current to the spark plugs in proper time. Timing of the distributor point opening is controlled by manual setting and a centrifugal spark-advance mechanism. Under part-throttle conditions, an additional advance is accomplished by the vacuum advance mechanism.

### Maintenance

Dirty or slightly burned breaker points should be cleaned up by the use of a point file, which is made especially for this purpose. Emery cloth should not be used. The contacting surfaces must be flat and even to insure a parallel contact. To obtain this, the moving point must be slightly pressed against the fixed point while moving the file between them.

Clean the interior of the distributor with compressed air. The cam lobes should be slightly greased with Universal Grease VW - A 052 to reduce wear of the fiber block to a minimum.



It is recommended to add a few drops of engine oil down the shaft through the contact breaker plate when carrying out the first service inspection of the car, but care should be taken that no oil comes into contact with the breaker points.

The rotor finger and the four segments of the distributor cap are subjected to a certain amount of wear due to spark continuously occurring during operation. Troubles may occur if the insulating material of the distributor cap or the rotor is cracked. The cap must be kept clean and dry inside and out to avoid high-tension leakages and short circuits. When mounting the cap, make sure that the spring-loaded brush for the rotor is fitted.

### Adjusting Breaker Points

To adjust the breaker points proceed as follows:

- 1 - Remove distributor cap and rotor.
- 2 - Crank the engine until the fiber block on the breaker arm rests on the highest point of the cam lobe.
- 3 - Loosen the lock screw of the fixed breaker point.



- 4 - Turn the eccentric adjusting screw until the correct gap of 0.4 mm (.016") is obtained. Check with a feeler gauge.



- 5 - Tighten lock screw.

#### **Important!**

After the contact points have been adjusted, it is absolutely necessary to readjust the ignition timing, as a change of 0.1 mm (.004") in the amount of gap changes the ignition timing by about 3° of the crankshaft angle.

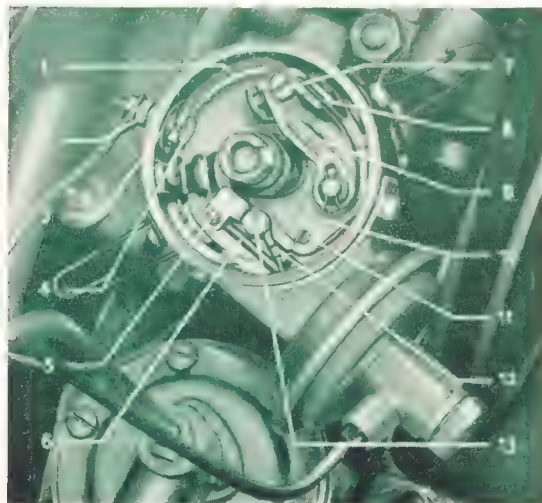
A correct opening and closing of the breaker points is only ensured, if there is no radial play in the distributor shaft and bearings.



## Replacing Breaker Points

The breaker points naturally wear during service by burning. If the point has been reached where an adjustment is no longer possible, or if the breaker points are badly burned, install a new set:

- 1 - Remove distributor cap and rotor.
- 2 - Disconnect low-tension cable from terminal 1 at distributor.
- 3 - Loosen nut of terminal screw and take off breaker arm cable.
- 4 - Remove spring clip and washer from breaker arm pin.
- 5 - Disconnect breaker arm spring and insulation from the terminal on the breaker plate and remove breaker arm.
- 6 - Remove breaker point lock screw.
- 7 - Remove screw of vacuum pull rod bracket.
- 8 - Take off breaker point.  
When fitting the new breaker arm, note proper position of insulation to avoid short circuits at this point.
- 9 - Tighten screw of vacuum pull rod bracket.
- 10 - Connect low-tension cable.
- 11 - Reset breaker point gap and ignition timing.



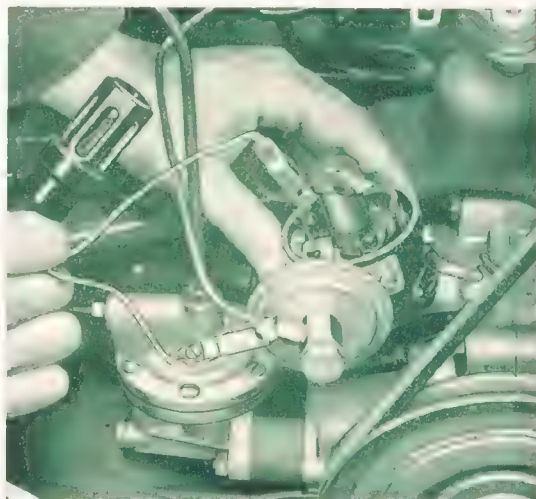
- |                             |                       |
|-----------------------------|-----------------------|
| 1 - Primary lead            | 7 - Lock screw        |
| 2 - Primary lead connection | 8 - Insulating washer |
| 3 - Insulating washer       | 9 - Breaker arm       |
| 4 - Terminal screw          | 10 - Breaker point    |
| 5 - Pull rod bracket        | 11 - Adjusting screw  |
| 6 - Vacuum pull rod         | 12 - Ground lead      |
|                             | 13 - Bracket screw    |

## Ignition Timing

The ignition timing should always be set with the engine cold.

Prior to timing the ignition to 7.5° before top dead center, the breaker point gap must be checked.

- 1 - Crank the engine until the mark of the crankshaft pulley lines up with the vertical crankcase jointing faces and the distributor rotor arm is in the position for firing on the No. 1 cylinder (see mark on rim of distributor base).
- 2 - Loosen clamp screw of distributor retainer.
- 3 - Connect one lead of 6-volt test lamp to terminal 1 at distributor and the other to ground.
- 4 - Switch on ignition.
- 5 - Rotate the distributor body clockwise until the contact points are closed and then slowly anti-clockwise until the breaker points are just about to open and the test lamp lights up.



- 6 - Tighten clamp screw of distributor retainer.
- 7 - Refit rotor and distributor cap.

The ignition is correctly timed for all four cylinders, if the lamp lights up when the mark on the pulley is exactly in its highest or lowest position (in line with the crankcase jointing faces) while slowly cranking the engine.

### Centrifugal Advance Mechanism

The centrifugal mechanism consists of two weights that throw out against spring tension. This movement is transmitted through a toggle arrangement to the breaker cam, causing it to advance or move ahead with respect to the distributor drive shaft as engine speed increases (max.  $26^{\circ}$ ).

Under part-load conditions, an additional spark advance is accomplished by the vacuum advance mechanism being connected to the carburetor. The vacuum taken from the carburetor actuates the diaphragm in the vacuum chamber. The movement of the diaphragm is transmitted to the breaker plate by means of a pull rod, causing the breaker plate with the points to move ahead with respect to the distributor drive shaft.

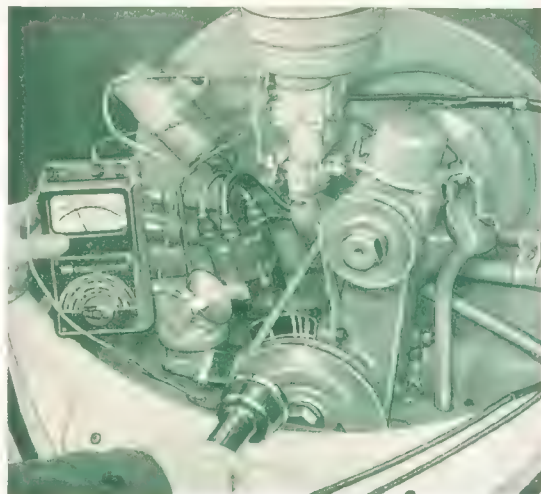
### Testing Centrifugal Advance Mechanism

The effect of the advance mechanism can be checked by turning the mounted rotor clockwise up to the stop. The rotor must move back to its original position, that is, to the opposite stop when it is released. Otherwise the advance mechanism is dirty or the spring tension is incorrect. The ignition timing indicator VW 342 enables the mechanic to carry out a precise checking of the advance mechanism in a simple manner.

A control scale (drawing No. VW 654, formerly VW 373, for local manufacture and Workshop Bulletin E/28), specially designed for the VW engine, is attached to the crankcase and shows in connection with the ignition testing light the setting of the ignition and the action of the centrifugal advance mechanism. A faulty setting, or mechanical troubles, evidenced by a too advanced, retarded, or uneven ignition timing, can easily be detected.

### Application:

- 1 - Disconnect vacuum line from ignition distributor and plug it up.
- 2 - Screw control scale on distributor mounting stud so that the scale slot is in line with the vertical crankcase jointing faces and the radius marked on the scale conforms with the outer diameter of the pulley.
- 3 - Draw a line 2—3 mm (.08"—.11") thick opposite to the ignition timing mark on the fan pulley with chalk or paint.
- 4 - Connect one lead of the testing light to the spark plug of cylinder No. 1 and the other lead to the disconnect spark plug cable (series connection).
- 5 - Connect tachometer.
- 6 - Start engine. — Hold testing light close to pulley and scale. The distributor functions properly if the white line on the pulley is steadily (not jerkily) moving within that field of the scale corresponding to the speed of the engine.



| White Line at: | Speed                 | Advanced ignition by centrifugal mechanism |
|----------------|-----------------------|--------------------------------------------|
| Scale Slot     | Standstill            | $7.5^{\circ}$                              |
| 1st Scale Line | Approx. 1200 R. P. M. | Approx. $8^{\circ}$ — $13^{\circ}$         |
| 2nd Scale Line | Approx. 2000 R. P. M. | Approx. $13.5^{\circ}$ — $16.5^{\circ}$    |
| 3rd Scale Line | Approx. 3300 R. P. M. | Approx. $31.5^{\circ}$ — $34.5^{\circ}$    |



### Testing Vacuum Advance Mechanism

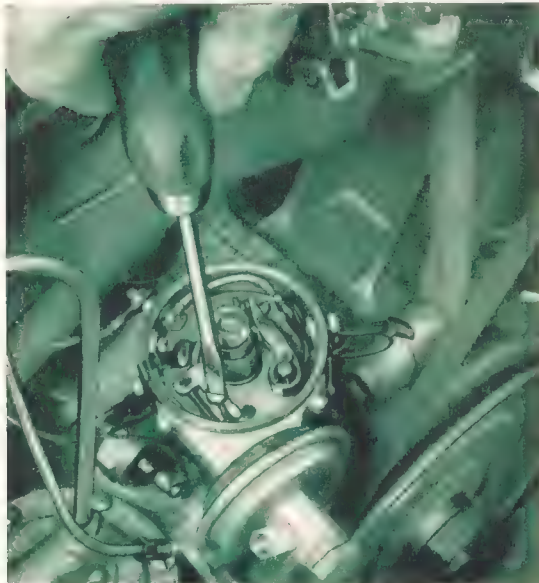
The vacuum advance is tested by comparing it with the centrifugal advance.

#### Procedure:

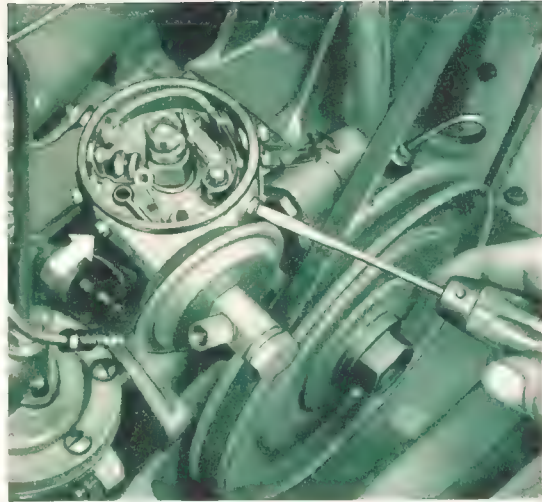
- 1 - Connect vacuum line.
- 2 - Let the engine run at approx. 2000 r.p.m. and point the light to the scale.  
  
Should no tachometer be available, it is advisable to determine the position of the throttle (by turning the idling adjusting screw) which had been obtained at the second scale line (2000 r. p. m.) when checking the centrifugal advance mechanism.
- 3 - The operation of the vacuum advance mechanism is correct if the advance is materially greater at 2000 r.p.m. than with the centrifugal mechanism only. If no increased advance is perceptible, check vacuum line and chamber for leaks. Renew damaged parts.

### Removing and Installing Vacuum Advance Mechanism

- 1 - Detach vacuum line from vacuum chamber assembly.
- 2 - Take off distributor cap and rotor.
- 3 - Take off pull rod bracket after having removed the screw.

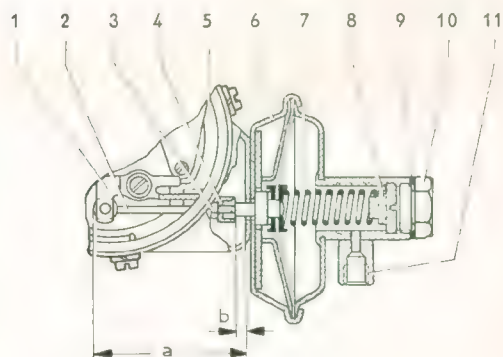


- 4 - Remove the two vacuum chamber attaching screws.
- 5 - Remove vacuum chamber and pull rod.



Installation is a reversal of the removal procedure, but the following points should be heeded:

- 1 - Reset breaker point gap and ignition timing.
- 2 - The spring in the vacuum chamber is set by the manufacturer by means of special tools and no attempt should be made to adjust it.
- 3 - Adjust pull rod (distance from vacuum chamber to pull rod end) to  $a = 43.4 \pm 0.2 \text{ mm}$  ( $1.709'' \pm .008''$ ).
- 4 - Adjust the adjusting nut on the pull rod (distance from nut face to vacuum chamber) to  $b = 3.5 \pm 0.15 \text{ mm}$  ( $.138'' \pm .006''$ ) and tighten counter nut.



- |                          |                             |
|--------------------------|-----------------------------|
| 1 - Pull rod bracket     | 7 - Vacuum chamber spring   |
| 2 - Pull rod             | 8 - Spring seat             |
| 3 - Counter nut          | 9 - Seal                    |
| 4 - Adjusting nut        | 10 - Plug                   |
| 5 - Ignition distributor | 11 - Vacuum line connection |
| 6 - Vacuum chamber       |                             |

$$a = 43.4 \pm 0.2 \text{ mm } (1.709'' \pm .008'')$$

$$b = 3.5 \pm 0.15 \text{ mm } (.138'' \pm .006'')$$



5 - Lightly grease pull rod with Universal Grease VW - A 052.

6 - Loosely attach vacuum chamber assy to the distributor.

7 - Tighten pull rod bracket screw and ground lead.

8 - Install rotor and bring the mark on the rotor in line with the mark on the edge of the distributor housing.

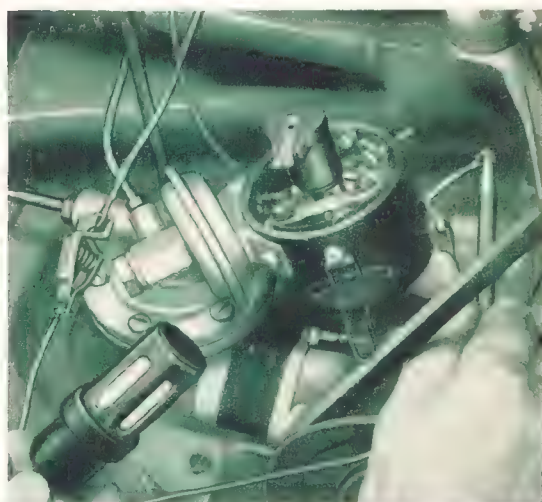
In this position, the breaker points should just have started to open (it is recommended to check by means of a 6-volt test lamp). Should it not be possible to obtain this condition by moving the vacuum chamber in the holes for the attaching screws, the dimension (a) of the pull rod should be altered and dimension (b) readjusted.

9 - Tighten vacuum chamber attaching screws.

### Testing Condenser

The condenser is very important to obtain the required high voltage for the ignition. It also reduces the spark occurring between the points when they separate to prevent a premature burning of the points.

A defective condenser is indicated by burned breaker points and weak spark in connection with difficult starting, or failure of the engine to start.



### Test

Modern testing equipment checks a condenser for high resistance, insulation leakage, and capacity.

If condenser testing equipment is not available, proceed as follows:

1 - Disconnect cable 1 and condenser cable at terminal of breaker arm.

2 - Connect the one lead of a 6-volt test lamp to terminal 1 at ignition coil and the other to the condenser cable.

3 - Switch on ignition. If the test lamp lights up, the condenser is grounded and should be replaced.

4 - Connect cable 1 and condenser cable.

5 - Disconnect high tension lead 4 at distributor cap and hold it approx.  $\frac{1}{4}$  inch from the crankcase or other suitable ground.

6 - Crank engine with ignition switched on. If no spark occurs at the prescribed distance, the check should be repeated with a new condenser.

Only use condenser of the prescribed type: ZKO 29/6 2 Z, as condensers of incorrect capacities will seriously affect breaker point life.

### Removing and Installing Distributor

1 - Detach vacuum line from vacuum chamber.

2 - Disconnect cable from terminal 1 at distributor (loosen breaker point terminal screw).

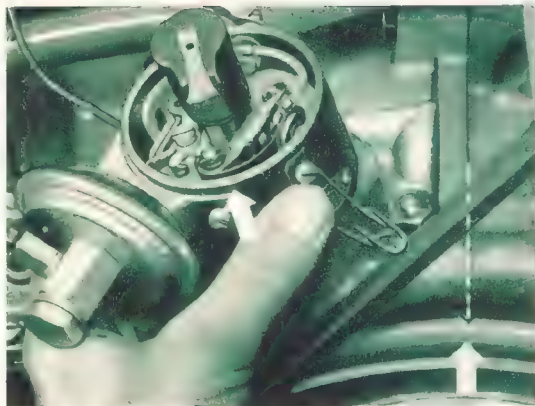
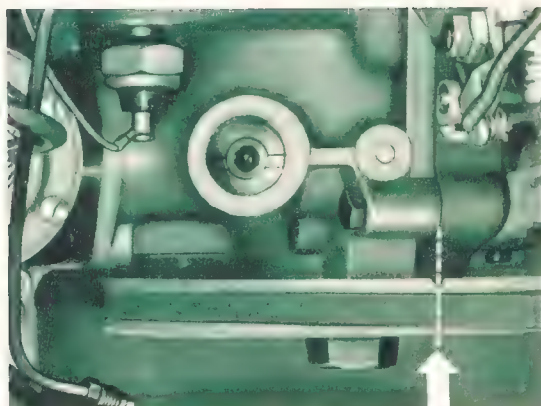
3 - Take off distributor cap.

4 - Remove clamp screw of distributor retainer.

5 - Lift off distributor.

Installing the distributor is done in the reverse order, but the following points should be noted:

1 - Crank the engine until it is in the position for firing on the No. 1 cylinder. The slot of the distributor drive pinion must then be offset towards the rear and nearly parallel to the fan pulley while the fan pulley mark is in line with the crankcase jointing faces.



- 2 - Make sure the distance spring is properly seated in the distributor drive pinion head.
- 3 - When installing distributor, turn distributor shaft until the finger of the rotor points to the mark for cylinder No. 1 on the base rim and the shaft end enters the slot in the distributor drive pinion.
- 4 - Time the ignition.

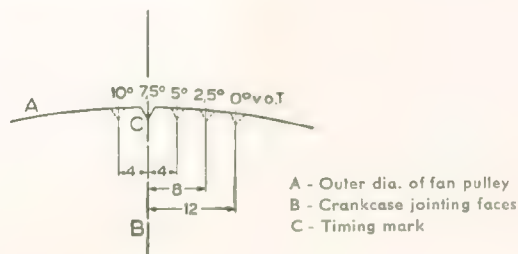
#### Note:

From Chassis No. 1 210 230 the vacuum line between the carburetor and the vacuum chamber at the distributor is bent to follow a different route than before.

On earlier cars, the vacuum line slightly rises from its connection at the carburetor and runs below the choke control cable along the fan housing to the vacuum chamber. The new line winds up from the carburetor by 10—15 mm (.39"—.59") and runs below the accelerator cable to the vacuum chamber in the shortest possible way. This modification has been made to simplify the layout and to prevent fuel from entering the vacuum chamber.

## Interchangeability of Ignition Distributors

The distributors BOSCH VJU 4 BR 2 and VJU 4 BR 3 used on 1192 c.c. engines up to Chassis No. 1-0702742 can be re-used when installing flat-head pistons; however the basic advance adjustment must be altered as indicated in the table below:



| Ignition Distributor BOSCH | 1192 c. c. Engine with compression ratio of 6.6:1 |                                                      |                      |                                                       | 1192 c. c. Engine with compression ratio of 6.1:1 |                                                     |                      |                                                     |
|----------------------------|---------------------------------------------------|------------------------------------------------------|----------------------|-------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------|----------------------|-----------------------------------------------------|
|                            | Fuel above 80 octane                              |                                                      | Fuel below 80 octane |                                                       | Fuel above 80 octane                              |                                                     | Fuel below 80 octane |                                                     |
|                            | Ignition timing                                   | Timing mark                                          | Ignition timing      | Timing mark                                           | Ignition timing                                   | Timing mark                                         | Ignition timing      | Timing mark                                         |
| VJU 4 BR 2                 | 2.5° before T. D. C.                              | 8 mm (.31") to the right of crankcase jointing faces | T. D. C.             | 12 mm (.47") to the right of crankcase jointing faces | 7.5° before T. D. C.                              | In line with crankcase jointing faces               | 7.5° before T. D. C. | In line with crankcase jointing faces               |
| VJU 4 BR 3                 | 5° before T. D. C.                                | 4 mm (.16") to the right of crankcase jointing faces | 2.5° before T. D. C. | 8 mm (.31") to the right of crankcase jointing faces  | 7.5° before T. D. C.                              | In line with crankcase jointing faces               | 7.5° before T. D. C. | In line with crankcase jointing faces               |
| VJU 4 BR 8                 | 7.5° before T. D. C.                              | In line with crankcase jointing faces                | 7.5° before T. D. C. | In line with crankcase jointing faces                 | 10° before T. D. C.                               | 4 mm (.16") to the left of crankcase jointing faces | 10° before T. D. C.  | 4 mm (.16") to the left of crankcase jointing faces |

### Points to observe

- 1 - Important for a correct timing is the position of the timing mark on the fan pulley to the crankcase jointing faces. For example "8 mm (.3") to the right" in the column "Timing Mark" means that the timing mark must be 8 mm (.3") to the right as measured from the crankcase jointing faces to obtain the required 2.5° before T. D. C. of the corresponding distributor.
- 2 - The antiknock qualities of ordinary fuel are now in Germany from 80 to 84 octane, and super fuels are rated between 86 and 90 octane (Res. F. 1).  
  
The octane rating of fuels in other countries will be given by the Service Department on request.
- 3 - With the Ignition Distributor VJU 4 BR 2 a loss of power of about 3 per cent is likely up to 1800 r.p.m. on account of the smaller amount of advance. At a speed of about 2200—2400 r.p.m. a slight gain in power can be expected, whereas the power will slightly drop again at higher speeds.
- 4 - The use of the Ignition Distributor VJU 4 BR 3 involves a slight loss of power and a somewhat higher fuel consumption, which is, however, practically immaterial.

Both distributors have a slight increase in the engine noise in common, this noise is particularly connected with the distributor VJU 4 BR 2. The noise must be put up with when not using distributor VJU 4 BR 8.

- 5 - The Ignition Distributor BOSCH VJU 4 BR 8 can also be installed on engines equipped with earlier type pistons. The basic adjustment must then be altered to 10 degrees before T. D. C. (timing mark is 4 mm to the left of the crankcase jointing faces).

### Note:

To be made dust-proof, the ignition distributor BOSCH VJU 4 BR 8 requires merely the installation of a cover plate (Part No. 919 135a) when operating in dust-laden atmosphere. It is **not** necessary to replace the rotor.

Up to Chassis No. 1 - 702 741 it is necessary to replace the rotor by that of the Part Number 919 141 a.

### Ignition Distributor and Screened Rotor

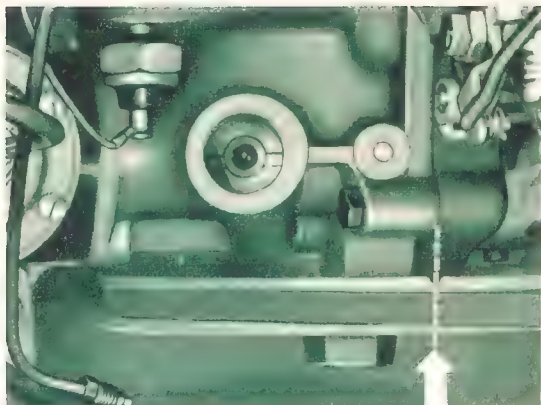
When installing a car radio, it should be made sure that the required screened rotor is of the right type to suit the distributor.

BOSCH distributors and screened rotors should be matched in accordance with the chart given below.

| Ignition Distributor      |                    | Engine No.                              | Distributor Cap | Standard Rotor | Screened Rotor | Dust Cover |
|---------------------------|--------------------|-----------------------------------------|-----------------|----------------|----------------|------------|
| Part No.                  | Bosch No.          |                                         | Part No.        | Part No.       | Part No.       | Part No.   |
| 919 021 a                 | ZV/VE 4 BR 383     | 1 to 695 281                            | 919 105 a       | 919 141 b      | 919 141 d*)    | 919 135    |
| 11 919 021 a discontinued | ZV/VJU 4 BR 3 (mk) | from 695 282                            | 919 105 b       | 919 141 c      | 919 141 e      | 919 135 a  |
| 11 919 021 b              | ZV/VJU 4 BR 8 (mk) | from 849 905 also suitable from 695 282 | 919 105 b       | 919 141 c      | 919 141 e      | 919 135 a  |

\*) Requires distributor cap Part No. 919 105



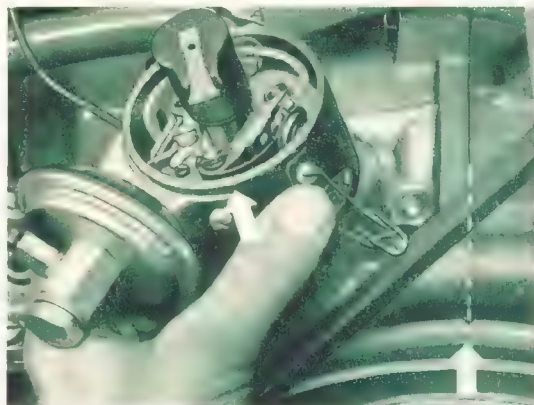


2 - Make sure the distance spring is properly seated in the distributor drive pinion head.

3 - When installing distributor, turn distributor shaft until the finger of the rotor points to the

mark for cylinder No. 1 on the base rim and the shaft end enters the slot in the distributor drive pinion.

4 - Time the ignition.



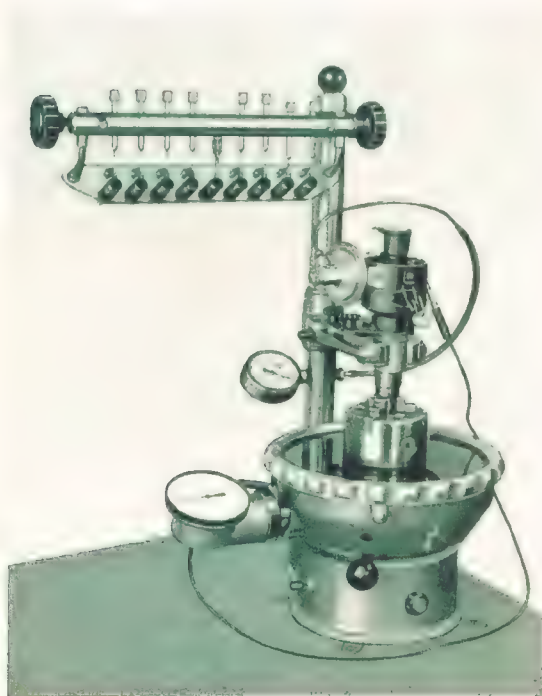
## Spark Advance Tests

### Ignition Distributor Types:

**BOSCH VJU 4 BR 3 mk**

**BOSCH VJU 4 BR 8 mk**

For an accurate checking of the centrifugal and vacuum advance, the distributor should be mounted in a suitable test stand.



The spark advance must comply with the specifications given on the reverse side.

To check the spark advance, the following procedure should be adopted:

- 1 - The centrifugal advance can be checked throughout the complete speed range, but it is generally sufficient to check at the crankshaft RPM printed in red.

If the spark advance is not up to the specifications, thoroughly check the centrifugal advance mechanism, including the springs. Clean, grease, or replace parts as found necessary.

### Important!

When disassembling distributor, note the position of the two weights, which are of different shapes.

To maintain peak engine performance, it is necessary to check the dwell angle whenever having the distributor disassembled or the breaker points replaced.

### Dwell angle of BOSCH Ignition Distributor

VJU 4 BR 3 mk = 50 to 55 degrees

VJU 4 BR 8 mk = 52 to 56 degrees

- 2 - If the centrifugal advance mechanism is found to operate perfectly, the vacuum advance should be checked at a constant RPM within a range where the centrifugal weights do not come into action (e.g., with the Bosch distributor VJU 4 BR 8 mk, this is between 1500 and 2000 crankshaft RPM). After the exact degree has been determined, the vacuum spark advance can be checked through the complete speed range by means of a vacuum pump.

The vacuum advance can be corrected by removing the vacuum chamber plug and adjusting the spring. If necessary, check vacuum chamber and vacuum line for leaks. Replace defective parts.

### Note:

The instruction given in page E 5—13 under point 2 (Installation) does not apply, if suitable testing equipment is available.

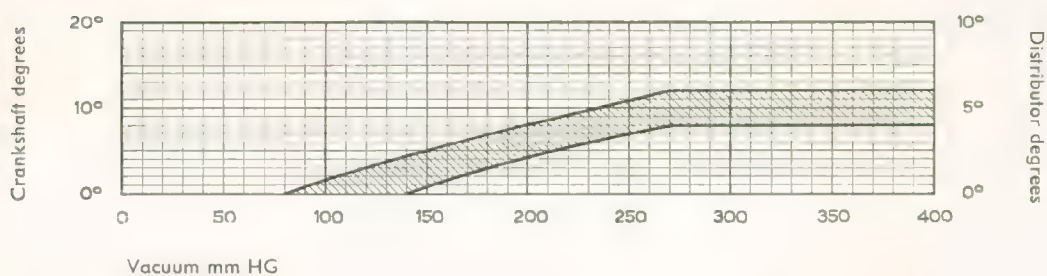
With the ignition distributor mounted on the engine, only the centrifugal spark advance should be checked with a timing light. The scale provided with a graduation from 0 to 35 degrees is attached to the crankcase and shows in connection with the ignition timing light the setting of the ignition and the action of the centrifugal advance mechanism.

## Ignition Distributor Bosch VJU 4 BR 8 mk

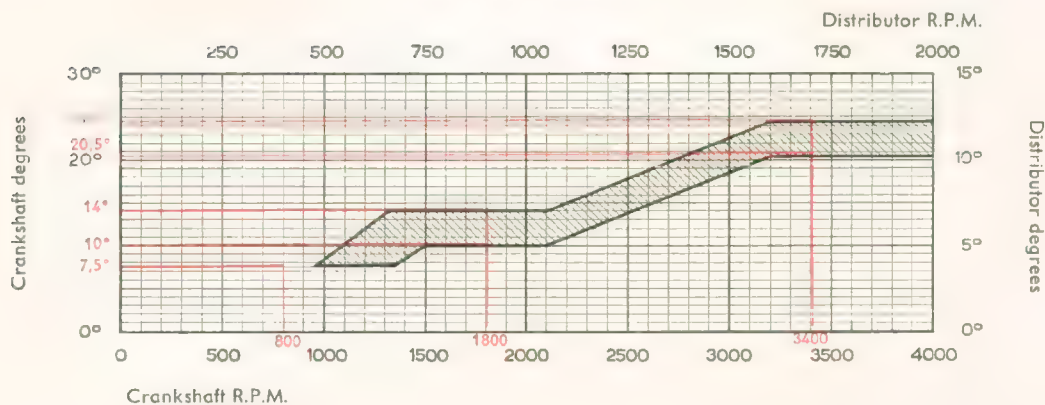
From Chassis No. 1 113 449

Beginning with the above chassis number, the centrifugal and vacuum spark advance curves of the ignition distributor BOSCH VJU 4 BR 8 mk have been slightly altered. The type number of the distributor remains unchanged. The figures and letters stamped on the distributor body above the fire protection screen indicate month and year of construction for easy identification. The modification in question is incorporated in all distributors of the aforementioned type from "3 M" onwards, the figure "3" standing for **March** and the letter "M" for **1956**. The months are indicated by the figures from 1 to 12, while the years are shown by letter in alphabetical order (e.g. M = 1956, N = 1957, etc.).

**Vacuum Advance**



**Centrifugal Advance**





## Ignition Timing

Special attention has to be paid to the checking and adjusting of ignition timing. Time and again it has been found that the ignition is advanced at will as compared to standard setting. Quite obviously, ignition advance is resorted to in order to increase engine output or to reduce fuel consumption. Actually, however, such an arbitrary advance will result in the permissible advance limits being exceeded in certain speed ranges. Engine output will then not be higher than with the specified ignition timing but operation will become abnormally noisy. Furthermore, working under load in the lower speed range, there will appear a certain tendency toward ignition knock while with the correct setting, and using normal gasoline (76 octane Res. F 1), the engine can be operated without any knock at all.

Consequently, it will be absolutely necessary to comply under all circumstances with the ignition timing specified for the engines of the various years of construction and for the requisite ignition distributors.

Adjustment of the ignition timing by means of the notch on the belt pulley and of the crankcase should be carried out only with the engine cold.

If the ignition is adjusted with the engine hot, there will be too much advance.

The distributor has a centrifugal governor and, in the case of VW Passenger Cars of recent production, a vacuum governor. Proper functioning and setting of this governing device are essential for the satisfactory operation of the engine. Ignition testing lamp and control scale are sufficient for a general check. If, on account of output, fuel consumption or engine noise, a more thorough ignition distributor check becomes necessary, such a check can be carried out accurately only on a special testing stand with the distributor removed. Applying the trial and error method with other distributors of which the correct setting is not known will not serve any useful purpose.

Engines found to have an arbitrarily advanced ignition setting should be adjusted to the correct timing without delay. In any event, it will be advisable to inform the customer accordingly. Prolonged operation at advanced ignition may result in a premature increase of main bearing play.

## Headlights

### General Description

The built-in headlights combine high beam, low beam and parking light. The two-filament bulb for the high and low beam and a ball lamp for the parking light are attached to one common holder, which is secured in position by a tension spring or a clip.

The headlight beams can be aimed vertically and horizontally.

### Lamp Types:

**Two-filament bulb B 6 V 35/35 W DIN 72601**

**Parking light bulb H 6 V 1.5 W DIN 72601**

### Bulb Replacement

- 1 - Loosen the slotted screw at the bottom of the headlight rim.
- 2 - Pull out the lens and reflector unit.
- 3 - Turn down clip or unhook tension spring and remove lamp holder.

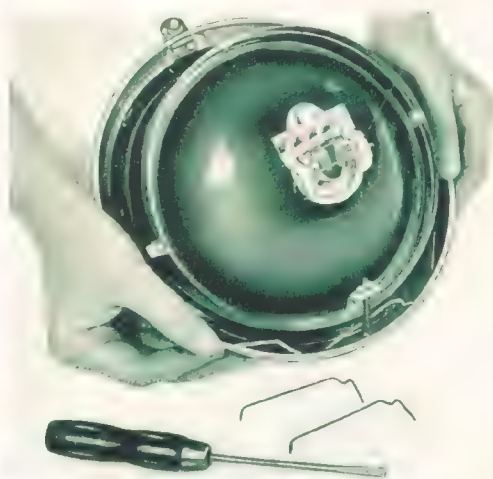


- 4 - Replace bulb.

When replacing a bulb, make sure the new bulb is clean and not loose in its socket. Only use bulbs recommended or supplied by the factory. Never use headlight bulbs which differ in colour or candlepower.

### Lens Replacement

- 1 - Remove lens and reflector unit.
- 2 - Take off lamp holder.
- 3 - Remove lens retaining spring clips from rim by means of a screwdriver (Bosch Headlights: 8 spring clips; Hella Headlights: 2 spring clips).
- 4 - Lift up retaining ring and reflector so that the lens and gasket can be removed.
- 5 - Place gasket on new lens and put the lens in the rim, taking care that the VW sign is upright.
- 6 - Place retaining ring and reflector in position and check if gasket is correctly seated between rim and retaining ring.
- 7 - Refit spring clips.



When replacing a lens, the reflector must not be touched, as the effect of the sensitive reflecting surface may otherwise be considerably reduced.

## Aiming Headlights

Headlight beams can easily and quickly be aimed by devices which consist of a series of prisms and reflectors that throw a miniature pattern of the

illuminating pattern on a screen, only a foot or so from the lens.

If such equipment is not available, the headlight can be aimed by means of a screen as instructed below:

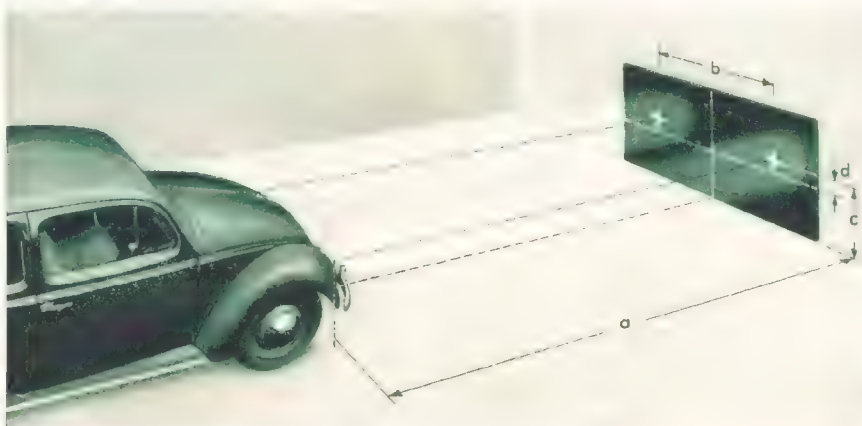


Stop the car on a smooth, level floor with a dark-coloured vertical screen 5 m (16 feet 5 in.) ahead. The car should be normally laden and the tires properly inflated to assure correct adjustment. The center line of the car must hit the center of the screen exactly between the two cross marks. Switch on the high beams and check the illuminating patterns at the cross marks.

Independent adjustment of both horizontal and vertical aim is provided with the adjustment screws in the headlight rim.

After aiming has been completed, switch on low beams and check distance between the upper limit of the light spot and the center of the cross which should amount to 5 cm (2").

| Dimensions for Screen |                                                              |                       |
|-----------------------|--------------------------------------------------------------|-----------------------|
| a                     | Distance from lens to screen                                 | 5 m (16 ft. 5 in.)    |
| b                     | Distance between crosses                                     | 1104 mm (3 ft. 7 in.) |
| c                     | Height of crosses                                            | 610 mm (2 ft.)        |
| d                     | Distance between upper limit of low beam and center of cross | 50 mm (2")            |





BOSCH



HELLA



| Adjustment        | Bosch                                                                                 | Hella                                                                                |
|-------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>Vertical</b>   | Turn upper screw<br>to right — beam swings down<br>to left — beam swings up           | Turn left screw<br>to right — beam swings up<br>to left — beam swings down           |
| <b>Horizontal</b> | Turn right screw<br>to right — beams swings to left<br>to left — beam swings to right | Turn right screw<br>to right — beam swings to right<br>to left — beam swings to left |

("Right" and "Left" screw means in driving direction)

## Headlight Indicator Lamp

### General Description

When switching on the high beam, a blue control lamp in the instrument board lights up. The lamp is connected with the cable to terminal 56 a (high beam) of the right headlamp.

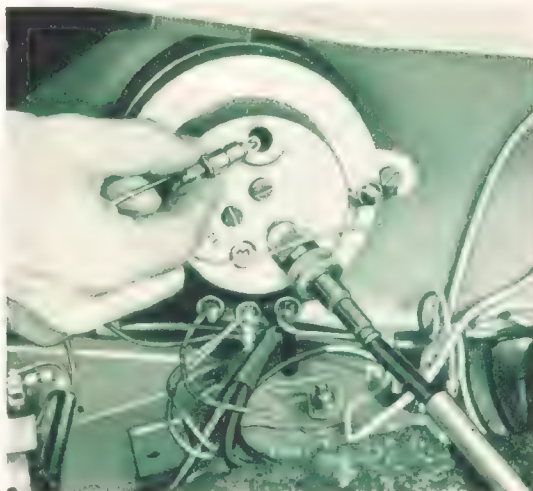
### Lamp Type:

Indicator lamp J 6 V 1.2 W DIN 72601

### Bulb Replacement

The bulb is accessible after the front hood has been opened and the lining in front of the instrument panel turned down.

- 1 - Pull out socket and bulb.
- 2 - Slightly press bulb into its socket, turn it slightly and pull it out.



## License Plate Light

### General Description

The license plate light housing is fitted to the rear hood and is accessible by opening the rear hood.

### Lamp Type:

License plate light bulb L 6 V 5 W DIN 72601

### Bulb Replacement

- 1 - Open rear hood.
- 2 - Remove wing nuts and take off lamp holder.
- 3 - Replace bulb.

To make sure that the bulb is tightly seated and makes good contact, check the pre-tension of the contact springs and clean them if dirt is present. Check housing gasket and renew it if found necessary.



### Note:

From August 1951 the number plate light on the rear hood is provided with a dome-shaped diffusing lens and is positioned higher for better illumination of the new number plate. The tubular-shaped bulb is replaced by a 10 Watt bulb G 6 V 10 W DIN T 2601.

## Stop Light Switch

### Mechanical Brake

The stop light switch of the mechanical brake is situated under the frame head cover and is operated by the foot brake push bar.

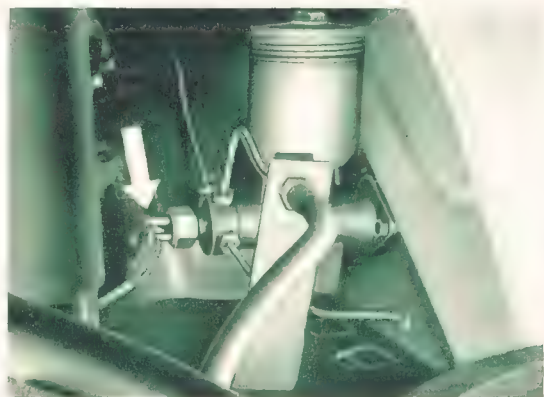
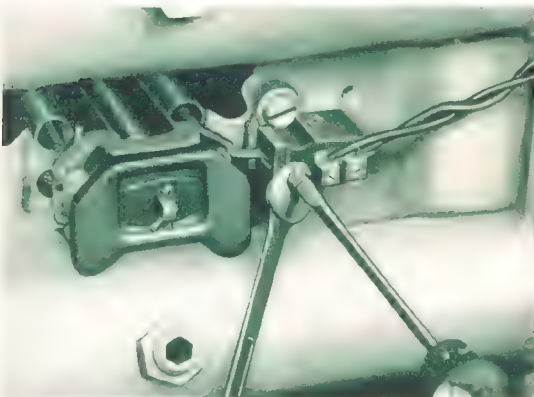
### Adjustment:

- 1 - Remove frame head cover.
- 2 - Pull parking brake lever by two notches.
- 3 - Loosen counternut of adjusting screw.

- 4 - Turn adjusting screw until stop lamp lights up; then turn it back until the lamp is just going out.
- 5 - Tighten counternut of adjusting screw.
- 6 - Replace frame head cover.

### Hydraulic Brake:

The stop light switch of the hydraulic brake is situated at the brake master cylinder and is not adjustable.



## Stop and Tail Lights

### General Description

The combined stop and tail lights, including reflectors, are located one on each rear fender.

### Lamp Types:

**Stop light bulb F 6 V 15 W DIN 72601**

**Tail light bulb G 6 V 5 W DIN 72601**

### Bulb Replacement

- 1 - Remove slotted screws and take off stop and tail light housing.
- 2 - Replace the bulbs, taking care that they are tightly seated and make good contact.
- 3 - Check condition of housing gasket and renew it if found necessary.
- 4 - The lamp holder can be taken off by disconnecting the cable and removing the nuts accessible from under the fender.



#### Note:

When replacing the tail lamp glass or the reflector glass, use Sealing Compound D 15 to obtain a perfect seal. Take about 10 grammes (.35 oz.) of the compound, knead it in the hand and roll a sort of strand of about 3 mm diam. (.12").

## Interior Light

### General Description

The interior light, operated by a tumbler switch below the instrument panel, is situated in the left-hand roof side member above the door pillar. The interior light incorporates a tumbler switch which permits the light to be switched off with the doors of the De Luxe or Convertible open.

### Lamp Type:

**Bulb L 6 V 5 W DIN 72601**

### Bulb Replacement

- 1 - Grip the interior light rim at both ends, and pull it off the roof side member.
- 2 - Replace the bulb, taking care that it is tightly seated and makes good contact.



### Door Contact Switch

The Volkswagen De Luxe and Convertible are additionally fitted with a door contact switch on each side. They are parallel connected to the switch in the instrument board and operate the interior light when a door is opened.



## Removing and Installing Door Contact Switch



1 - Open front hood and turn down the lining in front of the instrument panel.



2 - Remove contact switch retaining screws.

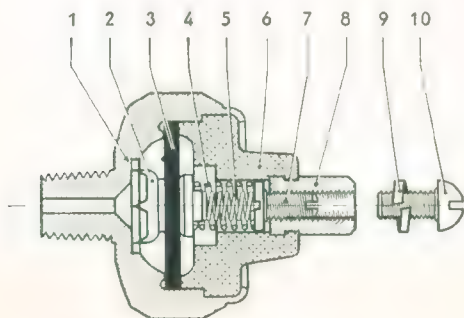
3 - Withdraw contact switch and disconnect cable. Installation is a reversal of the preceding operations.

## Oil Pressure Switch

### General Description

The oil pressure switch is installed in the oil pressure line between oil pump and oil cooler. With the engine not operating, the spring-loaded contact, which is connected with a diaphragm, is closed. After the ignition had been switched on, battery current flows from terminal 15 of the ignition switch through the green warning lamp and the oil pressure switch to ground. The green warning lamp lights up.

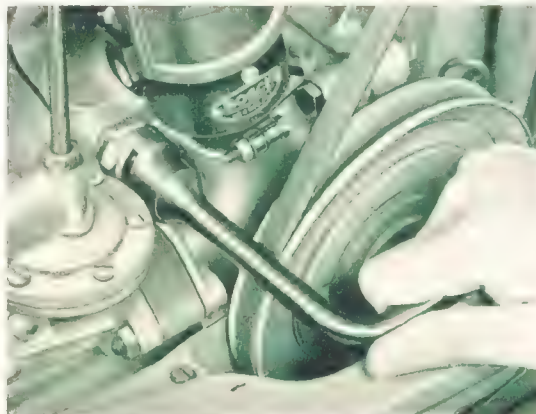
With the engine operating, the oil pressure actuates the diaphragm. The contact opens and the green warning lamp goes out.



- |                            |                     |
|----------------------------|---------------------|
| 1 - Switch body            | 6 - Insulation      |
| 2 - Contact                | 7 - Adjusting screw |
| 3 - Diaphragm              | 8 - Terminal        |
| 4 - Pressure spring, outer | 9 - Lockring        |
| 5 - Pressure spring, inner | 10 - End Screw      |

### Removal

- 1 - Disconnect cable at oil pressure switch.
- 2 - Remove oil pressure switch with wrench VW 159.



### Installation

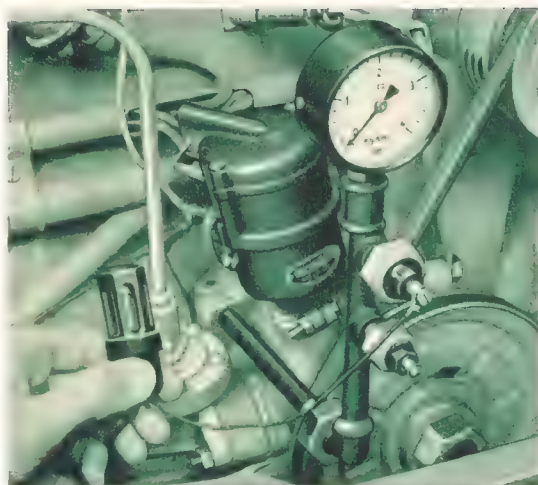
Sealing is effected by the tapered thread. Do not use undue force to tighten the switch to avoid damaging the thread.

After installation, the switch should be checked in connection with the green warning light in the speedometer dial.

### Adjusting Oil Pressure Switch

The oil pressure switch can be adjusted by means of special testing equipment or, on the engine, by a simple testing device with a manometer (drawing VW 963 for local manufacture) and a test lamp, after the engine has attained operating temperature.

- 1 - Screw oil pressure switch into the testing device.
- 2 - Screw testing device into seat for oil pressure switch and connect one lead of the test lamp to the oil pressure switch and the other lead to terminal 15 at ignition coil. The test lamp should then light up. Otherwise, turn the adjusting screw clockwise by a narrow screwdriver. If the lamp does not light up, the switch is defective and must be replaced.
- 3 - Start engine. The lamp must go out when the manometer indicates pressure above 0.4—0.6 atm. (5.7—8.5 lbs./sq. in.) At a lower pressure, the contact should be closed and the lamp light up. With the engine cold, the lamp should go out at normal idling speed, and with the engine warm, it should go out as the speed increases.



If the lamp goes out too late, the adjusting screw must be turned anti-clockwise.

- 4 - Stop engine. The test lamp is likely to go out later, as the oil pressure decreases slowly.

Beside an adjustment of the pressure switch, no other maintenance operations are required.

## Oil Pressure Warning Lamp

### General Description

The green oil pressure warning lamp is between terminal 15 at ignition switch and oil pressure switch terminal. The warning lamp lights up when switching on the ignition and at low oil pressure.

### Lamp Type:

**Warning Lamp J 6 V 1.2 W DIN 72601**

### Replacing Bulb

The lamp is accessible after the front hood has been opened and the lining in front of the instrument panel removed.

- 1 - Pull out socket and bulb from speedometer.
- 2 - Slightly press down the bulb into its socket, turn it slightly and pull it out.

### Note:

If the lamp lights up continuously during the ride, the chances are that the oil circulation has been interrupted, which means that the lubrication of the engine has ceased.

An occasional lighting up of the lamp with the engine warm and at low speed does not indicate trouble, if it goes out again as the speed increases. At low outside temperatures the lamp lights up in general only at idling speed, but at high outside temperatures the lamp may also light up at low speed in the various gears, or when changing gears, if the engine oil has a very low viscosity.

The engine oils now in use are of a comparatively low viscosity. This is advantageous with a view to an easy starting of a cold engine (low frictional loss) and favourable lubricating and cooling conditions of all moving parts, as there is a high velocity of the oil circulation at comparatively low pressure. If the oil pressure control lamp goes out not earlier than at high speeds, check adjustment of oil pressure switch before suspecting any other part.

## Stop and Tail Lights

(From August 1955)

### Description

Each rear fender carries a combined stop and tail lamp with reflex reflector and a two-filament bulb.

### Lamp Type

Two filament bulb 6 V 5/20 W DIN 72601

### Bulb Replacement

- 1 - Take off the bezel after having removed the Phillips screw.
- 2 - Withdraw the bulb holder from the reflector.

- 5 - When placing the bezel in position, care should be taken to insure that the rubber strip lip embraces the bezel.

- 6 - The bezel mounting bracket can be taken off after removing the two nuts from below the fender.

### Reflex Reflector Replacement

- 1 - Take off the bezel after having removed the Phillips screw.
- 2 - Withdraw the bulb holder from the reflector.
- 3 - Remove reflector spring clip by pressing it out of the retaining noses. Take off reflector and reflex reflector (glass).



- 3 - Replace bulb. Make sure the bulb is tight and is making perfect contact.
- 4 - Be sure the rubber strip between bezel and fender is in perfect condition, replace if necessary.

- 4 - Install new reflex reflector.

- 5 - When placing the bezel in position, be sure the rubber strip lip embraces the bezel.



## Headlamps

### General Description

The flush fitting headlamps in the front fenders combine high beams, low beams, and parking lights (side lights). The two filament bulb for the high and low beams and the parking light bulb are attached to one common holder held in position by a tension spring.

Provision is made for the headlight beams to be aimed vertically and horizontally.

### Lamp Types:

**Twofilament bulb B 6 V 35/35 W DIN 72601**

**Parking light bulb H 6 V 2 W DIN 72601**

### Bulb Replacement

- 1 - Remove the slotted screw at the bottom of the front rim, and unhook the rim from the top engagement for removal.



- 2 - Loosen the fixing screw at the bottom of the light unit rim and pull out the light unit.



- 3 - Unhook the tension spring, and pull out the lamp holder.



- 4 - Replace the bulb.

When replacing a bulb, make sure the new bulb is clean and not loose in its socket. Only use bulbs recommended or supplied by the factory. Never use headlight bulbs which differ in colour or candle-power.

## Aiming Headlights

Access to the adjusting screws is obtained by removing the front rim.

### Vertical Adjustment

Turn lower screw

to right — beam swings up

to left — beam swings down

### Horizontal Adjustment

Turn right screw

to right — beam swings to left

to left — beam swings to right



## Stop and Tail Lights

### General Description

The combined stop/tail lights with reflex reflectors are flush fitting in the rear fenders. One bulb on each side serves for both direction indicator light and stop light. When applying the brake with the direction indicator turned on, one of the two stop lights flashes.

### Lamp Types:

**Stop light bulb 6 V 15 W**

**Tail light bulb L 6 V 5 W  
DIN 72601**

### Bulb Replacement

- 1 - Remove the two slotted screws and take off rim and lens.



- 2 - Replace bulbs. Be sure the bulbs make perfect contact in their sockets.



- 3 - In assembling, care should be taken to insure that the rim is properly seated and there is a perfect seal between fender and lens. If found necessary, take about 20 grammes (.7 oz.) of Sealing Compound D 15 and roll a sort of strand of about 3 mm (.12") dia.

### Stop/Tail Light Housing Replacement

- 1 - Remove the two slotted screws and take off rim and lens.
- 2 - Disconnect the cables.
- 3 - Open the rear hood and turn back the trim panel to gain access to the housing.
- 4 - Remove the two housing attaching screws, while holding the corresponding threaded plates from inside the engine compartment.



- 5 - Take off the housing from inside the engine compartment.
- 6 - Check condition of gasket between housing and fender, replace if found necessary.
- 7 - When installing the housing, make sure the gasket is properly seated.
- 8 - Be sure the holes for the lens rim fixing screws register with the corresponding holes of the threaded plates.



## License Plate Light

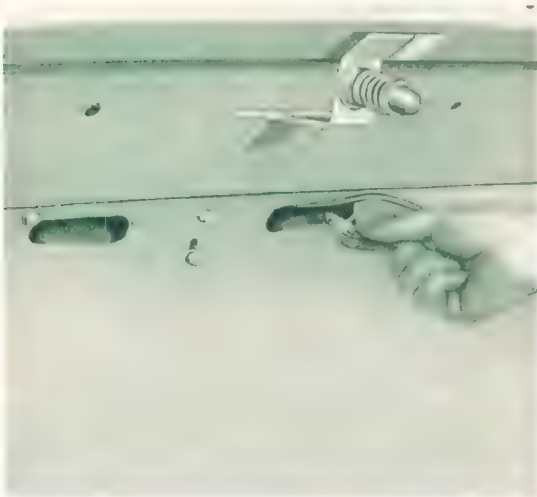
The two bulbs of the license plate light are accessible by opening the rear hood.

### Lamp Type:

**License plate light bulb L 6 V 5 W  
DIN 72601**

### Bulb Replacement

- 1 - Open rear hood.
- 2 - Remove bulbs through the openings and replace them.



### License Plate Light Housing Removal and Installation

- 1 - Remove the four nuts.



- 2 - Disconnect the cables and remove the bulbs.

- 3 - Take off rubber gasket.

To install, reverse the above procedure and make sure the rubber gasket is properly positioned.

## Interior Light

The interior lamp is automatically operated by opening or closing either of the doors. A manual three-position switch incorporated in the lamp fitting allows the light to be turned off with the doors open.

Positions of switch :

|              |                 |
|--------------|-----------------|
| Upper        | — on            |
| Intermediate | — off           |
| Lower        | — door contacts |

**Lamp Type:**

**Bulb 6 V 5 W DIN 72601**

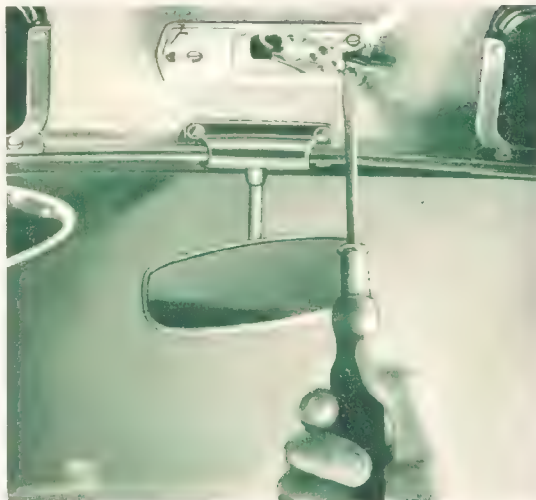
### Bulb Replacement

- 1 - Pull off glass and rim with both hands.
- 2 - Replace the bulb.



### Lamp Fitting Removal

- 1 - Pull off glass and rim.
- 2 - Remove the three fixing screws and take off the fitting.



- 3 - Disconnect the two cables.

To install, reverse the preceding operations and make sure the cables are properly connected.

### Door Contact Switch

Each door is provided with a contact switch, by means of which the interior light is automatically turned on with the lamp tumbler switch in the lower position.

### Door Contact Switch Replacement

- 1 - Pull door contact switch out of the door hinge pillar.



- 2 - Disconnect the cable.

## Windshield Wiper

### General Description

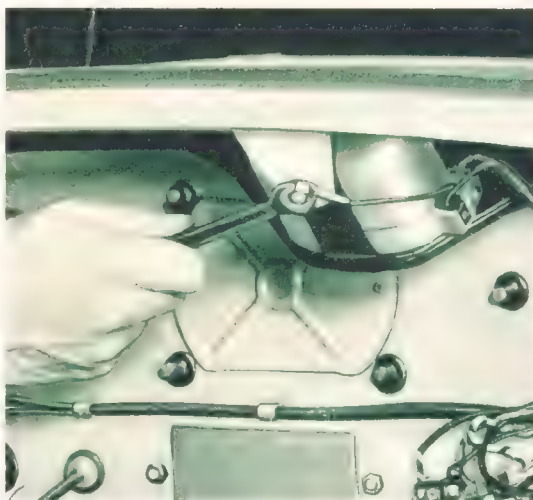
The windshield wiper motor and linkage for both wiper blades are attached to one common bracket, which is accessible after the front hood has been opened. The windshield wiper switch is to the right of the steering column.

### Maintenance

All moving joints of the windshield wiper gearing and linkage should be oiled at regular intervals. Check if the wiper blades bear evenly on the windshield and make sure that the sweep, or stroke, adjustment is correct, so that the sweep is not farther to one side than to the other.

### Removing and Installing Windshield Wiper

- 1 - Release fixing screw that holds wiper arms to the clamping brackets and take off wiper arms.
- 2 - Remove hex. nut with bonnet washer and outer rubber bush at both wiper arm bearings.
- 3 - Disconnect cable at windshield wiper motor.
- 4 - Remove bolt and nut that attach windshield wiper mounting bracket to body.
- 5 - Withdraw bracket complete with motor and linkage.



Installation is a reversal of the above, but the following points should be observed.

- 1 - Adjust mounting bracket by moving it in its clearance hole until the wiper bearing shaft is square to the windshield.
- 2 - Note correct arrangement of bonnet washers and rubber bushes.
- 3 - Connect ground cable.

## Electrical Horn

### General Descriptions

An electro-magnet in the horn produces vibration in connection with a breaker mechanism. The vibration is transmitted to the diaphragm, which produces the sound. A condenser or short circuit ring reduces the tension of the spark occurring between the points of the breaker mechanism to avoid damage by burning. The horn is operated by a push button switch on the steering wheel hub, which closes the circuit with ground (negative terminal of battery). Current is drawn through a brush in the steering column tube and a sliding contact ring on the steering column.

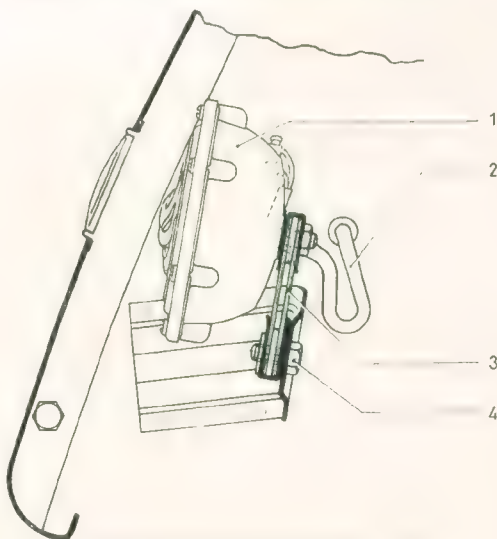
### Note:

From Chassis No. 1 - 0 950 000 the body of the electric horn — made by Hella — is covered with a perforated plate to prevent ingress of small stones. Additionally, the water drain slots are made wider to allow splash water that may have entered to drain off quickly.

### Maintenance

Care should be taken that the horn bracket is not damaged and the horn does not touch the body, as the vibration will otherwise be affected. Damage

may result from worn or dirty breaker points, ingress of water, and defective condenser.



- |           |             |
|-----------|-------------|
| 1 - Horn  | 3 - Bracket |
| 2 - Cable | 4 - Bolt    |



### Removing and Installing Electric Horn

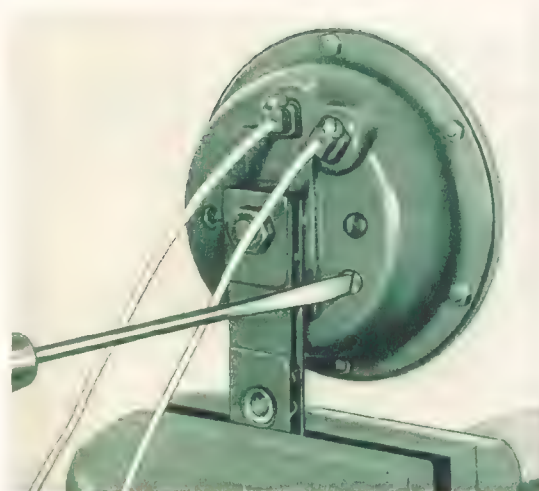
- 1 - Remove bolt at horn bracket under left-hand front fender.
- 2 - Disconnect cable and remove horn.

When installing the horn, make sure that it does not contact the body.

### Adjusting Electric Horn

The performance of the horn is affected by worn breaker points. An adjustment is made by means of the adjusting screw on the back of the housing.

- 1 - Remove horn.
- 2 - Clamp horn in a vise as shown by the illustration.
- 3 - Connect horn to a 6-volt battery, if possible in series with a contact button.
- 4 - Adjust horn by slowly turning the adjusting screw clockwise or anti-clockwise until the point is reached at which the horn is giving its best performance and the pitch of the tone is normal.



If, after having adjusted the breaker points, the horn is still uncertain in its action, giving only a choking sound, or does not vibrate, it should be replaced.

#### **Important!**

It may be appropriate to mention in this connection that the adjustment screw should be sealed with paint whenever the tone is readjusted. If neglecting this point, the horn will be rendered unserviceable by ingress of water.

## Electric Horn Feed Circuit

### Removing and Installing Horn Button

- 1 - Pry off horn button assy. by inserting a screwdriver in the slot.
- 2 - Release contact screw at horn button and take off button.

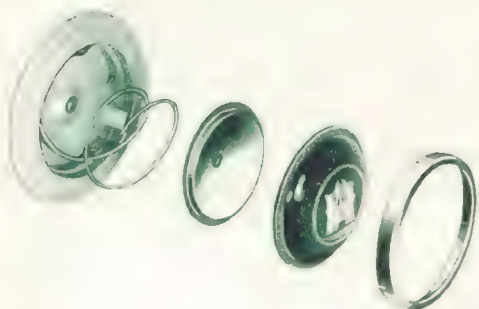
In installing the button, the following points should be noted:

- 1 - The insulation of the cable must be in perfect order.
- 2 - Make sure that the horn button assy. is tightly seated. Bend the spring, as necessary.



### Disassembly and Assembly of Horn Button

To insure a good contact, the contact surfaces must be free from dirt and corrosion.



If a replacement of parts or a cleaning is considered necessary, turn up the retaining ring lugs and take off retaining ring, button, and contact plate.

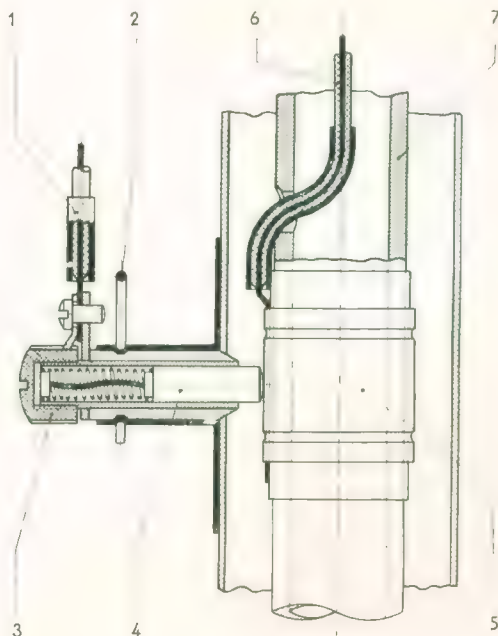


### Sliding Contact at Steering Column

The sliding contact between horn and horn button at the steering wheel hub is to take up the turns of the steering column. The horn may fail to operate if the contact is worn or dirty, or if the insulation is defective.

#### Replacing Brush

- 1 - Remove spring clip.
- 2 - Pull out brush holder with brush.
- 3 - Replace brush and spring.



- |                      |                          |
|----------------------|--------------------------|
| 1 - Cable to horn    | 5 - Contact ring         |
| 2 - Spring clip      | 6 - Cable to horn button |
| 3 - Tapped cap       | 7 - Steering column      |
| 4 - Brush and spring |                          |

#### Cleaning Contact Ring

- 1 - Remove brush holder with brush.
- 2 - Clean contact ring with a wooden stick and fine emery cloth by turning the steering column several times in both directions.

Make also sure that there is a good ground connection at the steering column coupling.

## Fuse Boxes

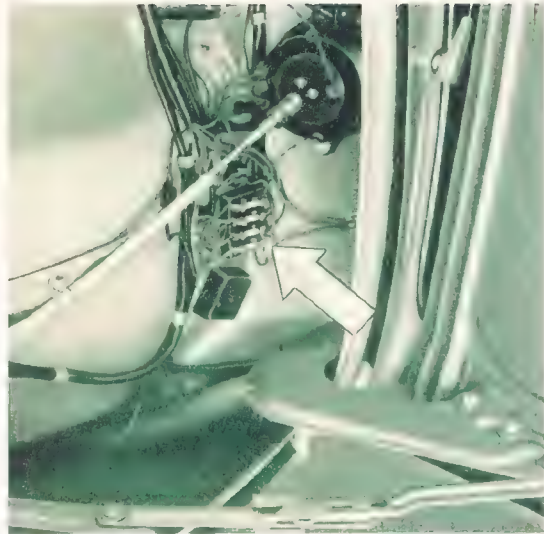
### General Note

Fuse boxes are located as follows:

- a - underneath the front hood, on the left side next to the fuel tank (6 fuses),



- b - underneath the front hood on the back of the instrument panel (4 fuses).



### Exchanging Fuses

A blown fuse can be removed by pressing down the retaining clip.

When a fuse has blown out, it is not sufficient to merely replace it by a new one. Inspect the electrical system for evidence of short circuits or other faults that may have caused the fuse to blow out.

Under no circumstances should any fuse be mended with tin-foil or wire, because this may result in severe damage to some other parts of the electrical system. It is important that replacement fuses should be of the correct capacity (8/15 amp.).

## Direction Indicators

### General Description

The built-in direction indicators are connected to the indicator lamp in speedometer. They are operated by the switch on the steering column. When one indicator is in the horizontal position, the control circuit is closed by a special contact in the direction indicator and the lamp lights up.

Each of the two direction indicators is illuminated by a bulb.

### Maintenance

As the direction indicators are exposed to weather influences, they should be cleaned from time to time. If, due to some fault, the arm does not come out, it can be prised out by means of a tool without the danger of causing damage. All parts should be cleaned with a brush and fuel.

Bearings and sliding surface may be lubricated with a few drops of corrosion-fighting chassis oil of low viscosity. Engine oil or grease must not be used.

After cleaning, the contact for the warning lamp and the connections should be checked.



### Replacing Bulb

Direction indicators of several makes are being installed which slightly differ from one another, but the various procedures of replacing the bulbs can easily be found out.



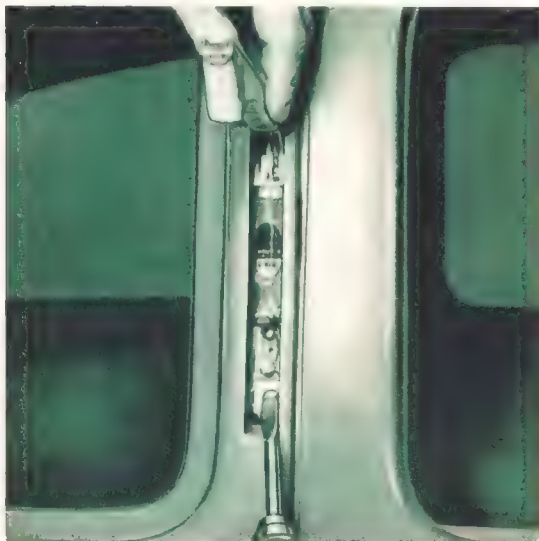
The arms may in all cases be pulled out and held in the horizontal position for replacing bulb, checking connections, and removal, without taking any precautions.

### Bulb Type:

**Direction Indicator Bulb**  
**M 6 V 3 W DIN 72601**

### Removing and Installing Direction Indicator

- 1 - Raise indicator arm in horizontal position.



- 2 - Release fixing screw in door pillar.

- 3 - Remove indicator arm from door pillar.

- 4 - Disconnect cables.

Installation is a reversal of the preceding operations, but the following points should be observed:

- 1 - Connect cables.

Upper terminal: blue-red cable.

Lower terminal: black-white, or black-green cable.

- 2 - To refit the indicator arm, slide the retaining bracket on the back of the arm in an upward direction into the slot of the door pillar as far as it will go. Hold the arm in this position while tightening the fixing screw.

- 3 - The indicator arm must not slide against the sides of its recess. Rectify a sticking arm by carefully bending it until it moves freely.

### Direction Indicator Warning Lamp

The red direction indicator warning lamp is between terminal 15 at ignition lock and the two cables to the control contacts of the indicators.

### Lamp Type:

### Warning Lamp

**I 6 V 1.2 W DIN 72601**

### Replacing Bulb

Access to the bulb is gained by opening the front hood and turning down the lining in front of the instrument panel.

- 1 - Pull out socket and bulb from speedometer.

- 2 - Slightly press down the bulb into its socket, turn it and pull it out.

## Windshield Wiper Motor

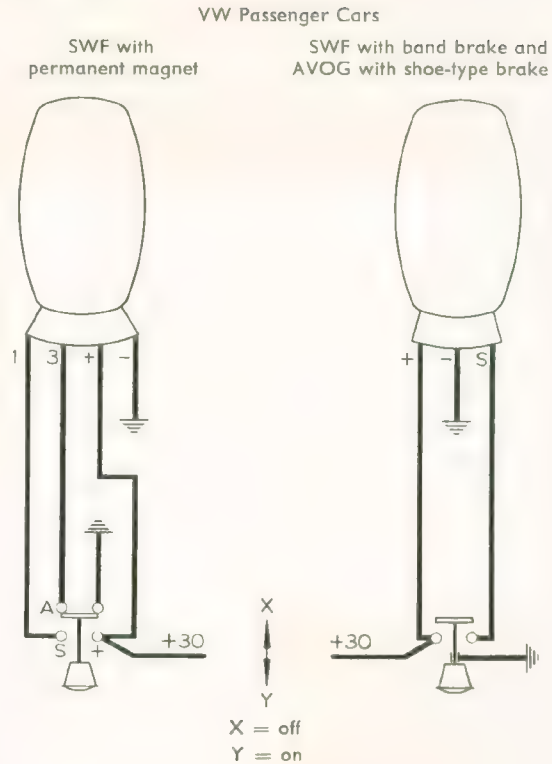
With effect from Chassis No. 1 438 742 VW de Luxe models are being provided with SWF wiper motors equipped with a permanent magnetic brake and a special push-pull type switch with 3 cable connections.

**SWF wiper motor** with magnetic brake  
(4 terminals)  
Part No. 113 955 111 A

1 push-pull type switch  
(3 terminals)  
Part No. 113 955 511 A

The different wirings are illustrated on the drawing. The new push-pull type switch with 3 terminals (previously 2 terminals) can be used with SWF motors with band brake (previous design) and AVOG motors with shoe-type brake. Both can be recognized by the 3 terminals.

The new SWF wiper motor is set for a higher number of wiper strokes, i.e., 44 strokes per minute as compared with 30 strokes per minute of the previous motor.



## Windshield Wipers

By decreasing the distance between the wiper arms and by installing longer wiper blades to match the new larger windshield, the wiping area has been considerably enlarged from Chassis No. 1 600 440. In the parked position the right hand wiper blade comes to rest nearer to the lower edge of the windshield.

The exchange of old windshield wiper assemblies (wiper motor, frame with linkage, wiper arm and blades) for those of new design is not possible. Parts of previous design will still be available.

## Windshield Wiper Motor

We have noticed repeatedly that windshield wiper motors are being exchanged even though they are not at all defective. In most cases the reasons for unsatisfactory operation were as follows:

- 1 - The switch operating knob has not been pulled out sufficiently. As a result, the contact strip may get stuck at a worn-off section of the material.
- 2 - Inadequate ground connection at the switch support bracket.
- 3 - Inadequate cable connections at the switch.
- 4 - Inadequate cable connections at the wiper motor and at the feed lines.
- 5 - Inadequate contact yoke pressure at the switch (can be remedied by rebending the yoke).

6 - Dirty contact surfaces.

- 7 - The switch operating knob has been screwed in too much so that it becomes impossible to switch the wiper motor off. This may happen when the inside thread of the knob is seated too far back or when the knob is screwed in so tightly that the small locking plate is bent backward.

In the event of any trouble with the windshield wiper, the switch should by all means be checked carefully to avoid subsequent complaints. This check can be carried out by testing with a switch that is in good working condition. A makeshift connection will be entirely sufficient for the purpose.



# Windshield Wiper Motor Trouble Checking

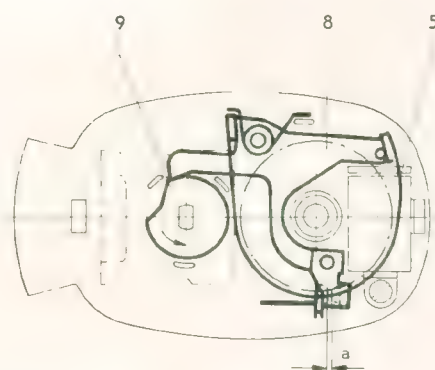
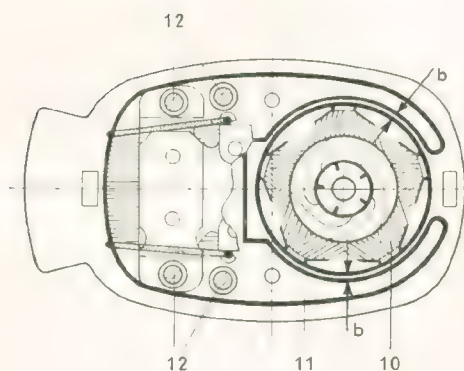
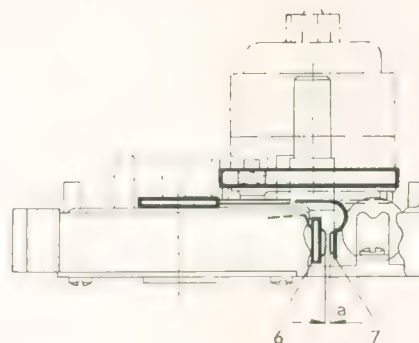
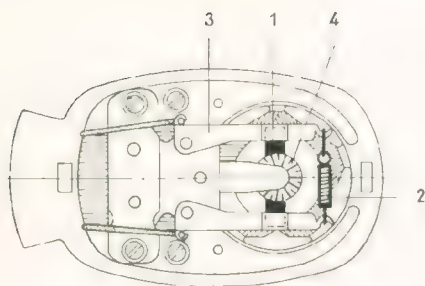
(VW De Luxe)

E

| Symptoms                                                                                                                          | Cause                                                                                                                                                                                                                                                                            | Remedy                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Windshield wiper motor operates too slowly, cuts out or comes to a standstill                                                     | <ul style="list-style-type: none"><li>a - Brushes (1) worn</li><li>b - Brush tension spring (2) too weak</li><li>c - Brush levers (3) not free on their pivots</li><li>d - Commutator (4) dirty</li><li>e - Moving joints of windshield wiper linkage devoid of grease</li></ul> | <ul style="list-style-type: none"><li>a - Replace brushes</li><li>b - Replace tension spring</li><li>c - Free the brush levers by working them backwards or forwards by hand and by applying a trace of thin machine oil</li><li>d - Clean the commutator</li><li>e - Thoroughly lubricate all moving joints with Universal Grease</li></ul> |
| Windshield wiper motor continues to run after manual switch is turned off                                                         | <ul style="list-style-type: none"><li>a - Brake band (5) effect not sufficient</li><li>b - Brake band broken</li></ul>                                                                                                                                                           | <ul style="list-style-type: none"><li>a - Increase servo effect of brake band by lightly greasing the brake band contact surface of the armature</li><li>b - Replace brake band. Gap of ground contact points (a): 0.8 mm (.031")</li></ul>                                                                                                  |
| Windshield wiper motor does not return the blades to parking position but stops at whatever point the manual switch is turned off | <ul style="list-style-type: none"><li>a - Excessive gap of ground contact points (6 and 7)</li><li>b - Cam (9) incorrectly reinstalled</li><li>c - Windshield wiper motor for right-hand drive car installed in left-hand drive car</li></ul>                                    | <ul style="list-style-type: none"><li>a - Check and adjust gap (a) to 0.8 mm (.031")</li><li>b - Correctly install the cam</li><li>c - Install correct windshield wiper motor</li></ul>                                                                                                                                                      |
| Gabbling noise when switching on the motor and in some cases delayed operation of motor                                           | Gap of ground contact points (6 and 7) too small                                                                                                                                                                                                                                 | Increase gap by bending ground contact to approx. 0.8 mm (.031")                                                                                                                                                                                                                                                                             |
| Squeaking noise of windshield wiper motor and in some cases connected with slow operation or burnt armature                       | <ul style="list-style-type: none"><li>a - Moving joints of windshield wiper linkages devoid of grease</li><li>b - Armature (10) fouls pole shoe (11)</li></ul>                                                                                                                   | <ul style="list-style-type: none"><li>a - Thoroughly grease all moving joints with Universal Grease</li><li>b - Check armature for free movement. If necessary, loosen the four shoe (b) into proper position</li></ul>                                                                                                                      |



| Symptoms                           | Cause                                                                                                                                                                                                                                                                                                                                                                                                                                          | Remedy                                                                                                                                                                                                                                              |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Windshield wiper motor inoperative | <p>a - Pole shoe (11) disarranged by blow on motor cap so that it makes contact with the armature (10)</p> <p>b - Armature burnt by short circuits, caused by disarranged pole shoe or overload due to the brake band not clearing the armature</p> <p>c - Nose of cam lever (8) of earlier type windshield wiper motors too deeply pressed into the lowest point of the cam (9) by deranging the wiper linkage in cleaning the windshield</p> | <p>a - Check armature for free movement (b). If necessary, loosen the four fixing screws (12) and bend pole shoe into proper position</p> <p>b - Replace the motor</p> <p>c - Bring the linkages to the normal rest position or replace the cam</p> |



- 1 - Brush
- 2 - Spring
- 3 - Brush lever
- 4 - Commutator
- 5 - Brake band
- 6 - Contact plate
- 7 - Contact spring
- 8 - Cam lever
- 9 - Cam
- 10 - Armature
- 11 - Pole shoe
- 12 - Four fixing screws

a = 0.8 mm (.031")

b = Free movement

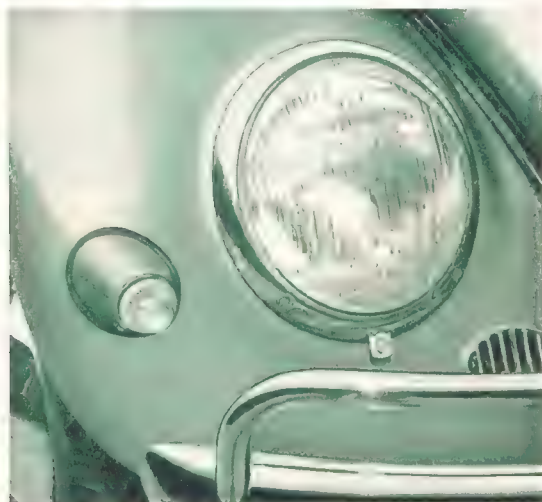
## Flashing Direction Indicators

(Used in some countries only)

### Description

The front direction indicator lamps flank the head-lamps. At the rear, the tail light, stop light, and

2 - Loosen the hex. nut with a box wrench.



direction indicator light are combined into one unit, one of the two filaments serving for both stop light and direction indicator light. The direction indicator switch returns automatically to the neutral position when turn is completed. The switch is connected to the flasher unit which opens and closes the circuits to the front and rear direction indicator lights and to the pilot light in the instrument panel.

3 - Take off bezel and lens after removing the two slotted screws.

### Lamp Type

Front bulb: R 6 V 20 W DIN 72601

Rear bulb: 6 V 5/20 W DIN 72601

### Front Bulb Replacement

1 - Pull rubber boot from bulb holder and disconnect the cable.



4 - Replace bulb.

5 - Be sure the rubber seal between bezel and fender is in perfect condition, replace if necessary.

6 - When tightening the nut, make sure the bezel is properly seated in the channel provided in the rubber seal.

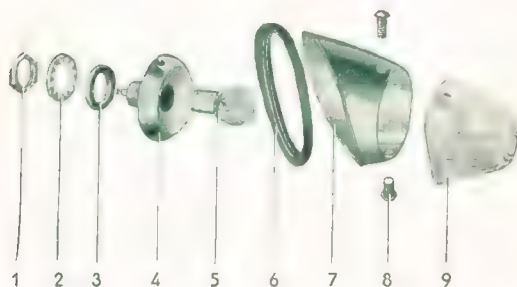
## Rear Bulb Replacement

To replace the direction indicator rear bulb, follow the instructions given under "Stop and Tail Lights" (from August 1955).

## Front Direction Indicator Lamp Assembly and Disassembly

### Disassembly

- 1 - Pull rubber boot from bulb holder and disconnect the cable.
- 2 - Take off the lamp unit after loosening the hex. nut.
- 3 - Remove the two slotted screws from the bezel.
- 4 - Remove bulb holder and bulb from bezel.
- 5 - Push out the lens toward the rear of the bezel.



- |                        |                   |
|------------------------|-------------------|
| 1 - Nut                | 6 - Bezel seal    |
| 2 - Shake-proof washer | 7 - Bezel         |
| 3 - Rubber seal        | 8 - Slotted screw |
| 4 - Bulb holder        | 9 - Lens          |
| 5 - Bulb               |                   |

### Assembly

To assemble the lamp, proceed in reverse order observing the following points:

- 1 - Put lens into bezel as shown in the picture.



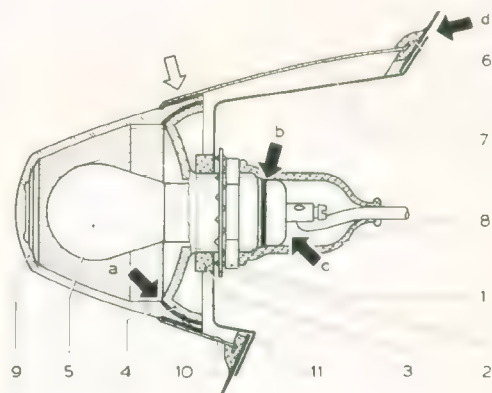
### Note:

From Chassis No. 1 168 937 the direction lamps are provided with a sealing compound D 15 between bezel (7) and lens (9) in current production (see white arrow). the opening (10) has been increased to 4 mm (.16"). Sealing compound should be additionally applied to the following points (see black arrows):

- a - Between lens (9) and bulb holder (4)
- b - At the soldered bulb socket
- c - At the slot between flange and fiber base of bulb holder
- d - Around the edge of the bezel support, especially between the spot welds.

Apply the sealing compound D 15 in the form of strands rolled to a diameter of about 4 mm (.16") dia.

It is important to make sure that the rubber seals (3 and 6) and the boot (8) are properly seated and the drain hole (10) is free from obstructions. It is recommended to increase the diameter of the hole to 4 mm (.16").



- |                        |                      |
|------------------------|----------------------|
| 1 - Hex. nut           | 6 - Bezel seal       |
| 2 - Shake-proof washer | 7 - Bezel            |
| 3 - Rubber seal        | 8 - Protective cover |
| 4 - Bulb holder        | 9 - Lens             |
| 5 - Bulb               | 10 - Drain hole      |
|                        | 11 - Bezel support   |



- 2 - When installing the direction indicator lamp the notches on the inside of the bulb holder must fit into the slots of the bezel support.
- 3 - It is important to make sure that the rubber seal between bezel and front fender is properly seated.

### Direction Indicator Pilot Light

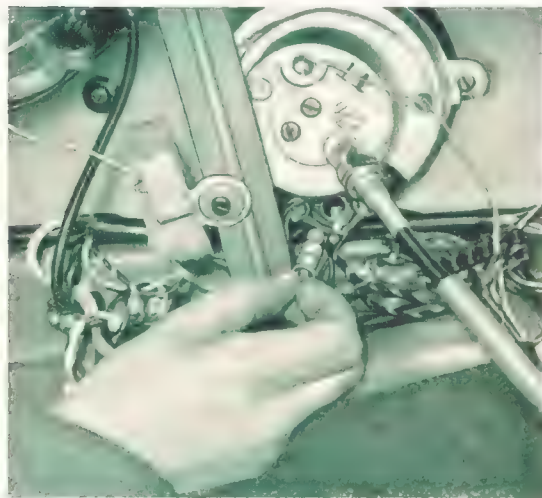
The direction indicator pilot light (red) is connected between terminal 15 and terminal K of the flasher unit.

### Lamp Type

Indicator bulb J 6 V 1.2 W DIN 72601

### Bulb Replacement

- 1 - Pull bulb and socket from back side of speedometer.
- 2 - Slightly press bulb into its socket and turn it until it can be pulled out.



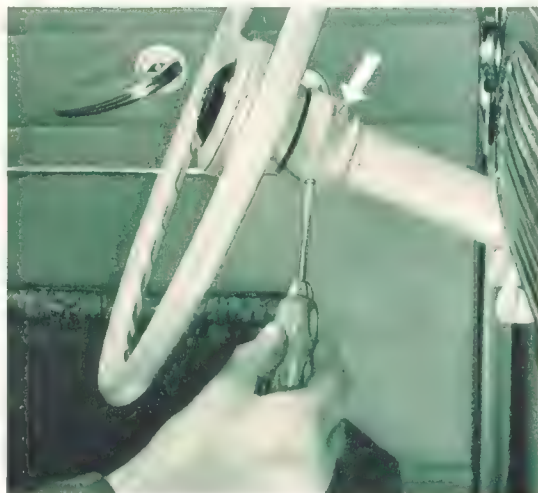
### Direction Indicator Switch Replacement

The direction indicator switch is mounted on the steering column below the steering wheel. This allows the driver to operate the switch lever without taking his hand off the wheel. The lever returns automatically to the neutral position when turn is completed.

To avoid short circuits, disconnect the positive cable from battery before carrying out the following operations:

### Removal

- 1 - Disconnect direction indicator switch cables in front luggage compartment.
- 2 - Remove the two direction indicator switch mounting screws.



- 3 - Take the cables out of the protection strip along the steering column and lift off the switch.
- 4 - Screw off the switch lever knob.



- 5 - Remove the switch cover attaching screws and take off the cover.



### Important!

Do not detach the soldered cable connections in the switch.

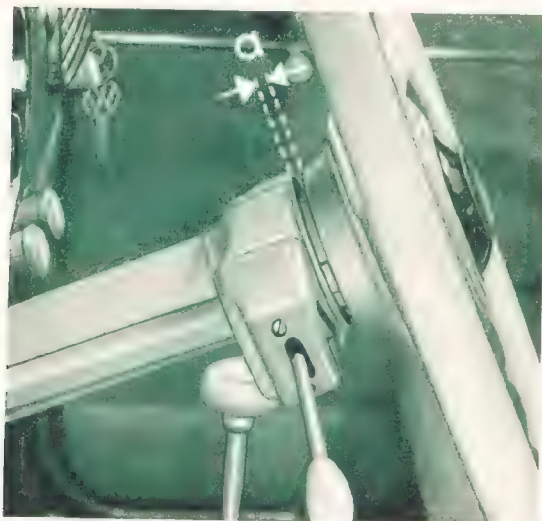
### Note:

Direction indicator switches are delivered with the cable connections soldered.

### Assembly

To install the switch, reverse the removal procedure and observe the following points:

- 1 - Make sure the cables are properly connected.
- 2 - Note proper position of cables and protection strip along steering column.
- 3 - Check direction indicator for proper functioning and automatic cancelling.
- 4 - The distance between the upper edge of the direction indicator switch and the lower edge



$a = 2 \text{ mm } (.08")$

of the steering column hub must be 2 mm (.08"), the automatic cancelling mechanism may otherwise fail to operate.

- 5 - If the lever does not return to the neutral position when turn is completed, correct the position of the switch by turning it either clockwise or anticlockwise on the steering column.
- 6 - Whenever installing the steering wheel, the contact nose in the steering wheel hub must be in line with the switch lever after the wheels are set in straight-ahead position.

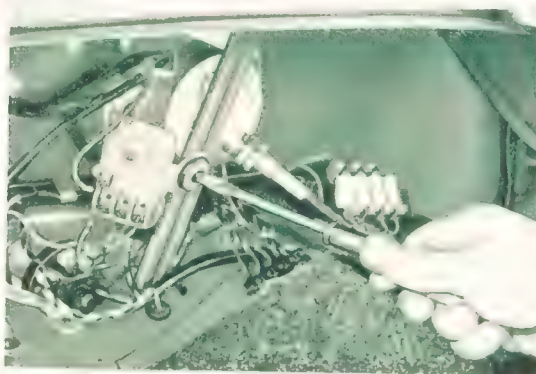


### Flasher Unit Replacement

In order to avoid short circuits disconnect the positive battery terminal before starting to work.

Access to the flasher unit is obtained by removing the cover from the back of the instrument panel.

- 1 - Disconnect the cables from the flasher unit.
- 2 - Remove flasher unit mounting screw.



- 3 - Install new flasher unit.
- 4 - Make sure the flasher unit is properly wired.

## Horn

### General Description

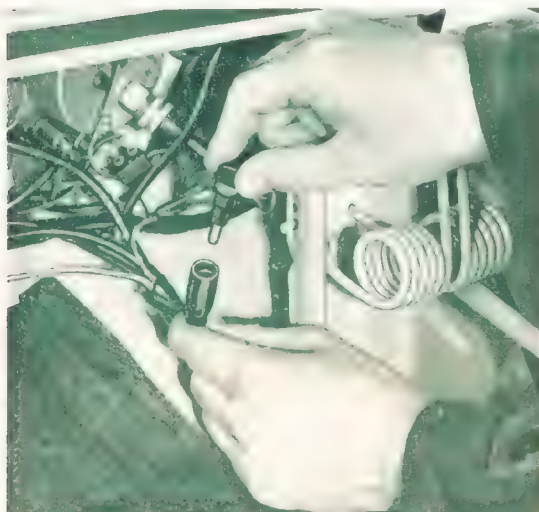
A matched pair of horns is located in the spare wheel compartment behind an opening that inclines downward. A rubber boot, screwed to the body by means of a retaining ring, encloses the horns and provides a perfect seal. The horns are operated by a button in the steering wheel hub via a relay. A connector provided with a fuse is in the cable between ignition switch and horn relay.

### Maintenance

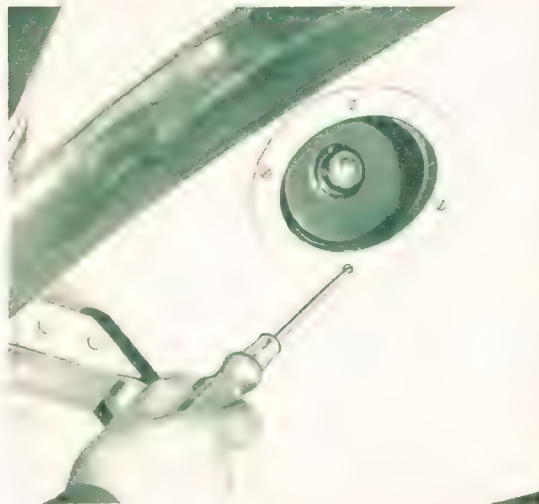
It is important to see that the flexible mounting parts and the rubber boot of the horns are free from damage.

### Horn Removal and Installation

- 1 - Remove the fuse from the connector.



- 2 - Remove the screws from rubber boot retaining ring.



- 3 - Remove the spare wheel and disconnect the horn cables.

- 4 - Remove horn mounting bolts and nuts, and lift out the horns and rubber boot.



- 5 - Remove horns from rubber boot.

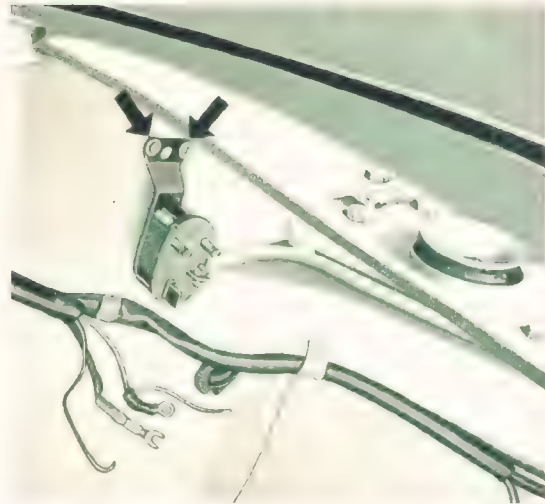
When installing, make sure there is a perfect ground connection and the rubber boot is properly positioned. The horns must not contact the body.



## Replacing Horn Relay

- 1 - Remove the fuse from the connector.
- 2 - Disconnect the four cables from the relay.
- 3 - Remove the two relay attaching screws.

When installing, make sure the cables are properly connected.



## Clock

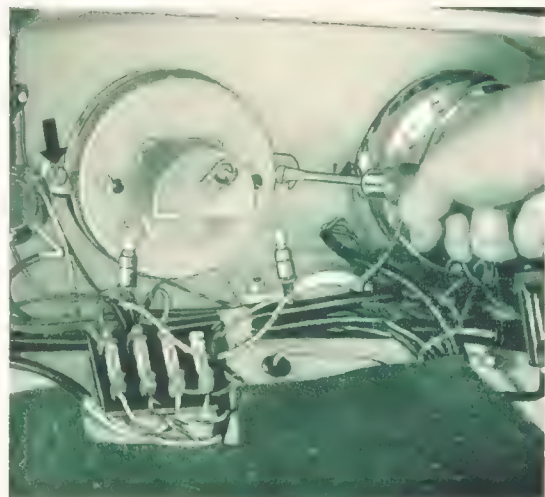
### General Description

The electrically driven clock is situated to the right of the speedometer. Should it become necessary to reset the clock, push in the knob in the center of the dial and turn to correct the time. The clock light is automatically switched on with the exterior lights. It is rheostat-controlled in conjunction with the instrument light.

### Clock Removal and Installation

#### Removal

- 1 - Remove front luggage compartment trim panel.
- 2 - Pull out the two bulbs and disconnect the clock supply cable.
- 3 - Remove the two clock attaching screws.
- 4 - Pull the clock off the instrument panel.



#### Installation

To install, reverse the preceding operations and make sure the clock is properly positioned before tightening the attaching screws.

## Flasher Units

On a number of Karmann Ghia Models, flasher units were installed which differ from those delivered as spare parts (Part No. 11 953 185) by having three terminals instead of four. When replacing old type flasher units (three terminals), the following points should be observed:

- 1 - Remove ground lead between direction indicator pilot light and left-hand speedometer fixing screw.
- 2 - Reconnect this ground lead to terminal 31 (negative) and to the mounting screw of the flasher unit.
- 3 - Connect an additional lead to the positive terminal of the generator and oil pressure warning lights and to the direction indicator pilot light.

## Windshield Wiper Motor

With effect from Chassis No. 1 331 899 Karmann Ghia Models are being provided with SWF wiper motors which are equipped with a permanent magnetic brake and a special push-pull type switch with 3 cable connections.

New design:

**SWF wiper motor** with magnetic brake  
(4 terminals)  
Part No. 141 955 111 A  
1 push-pull type switch  
(3 terminals)  
Part No. 141 955 511 A

Previous design:

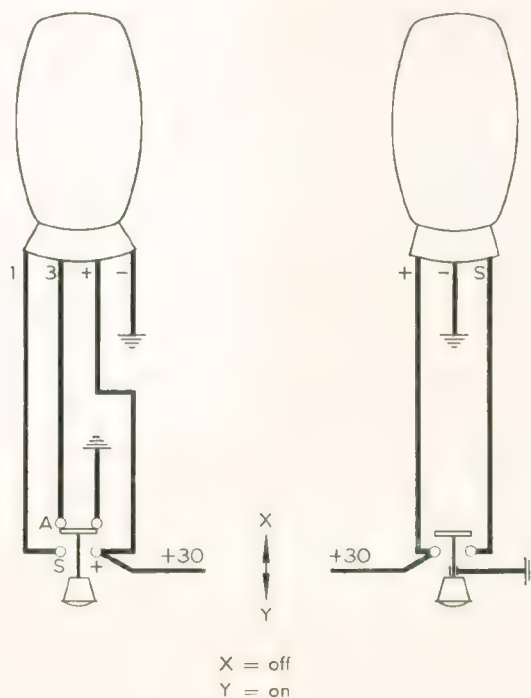
**SWF wiper motor** with band brake  
(3 terminals)  
Part No. 141 955 111  
1 push-pull type switch  
(2 terminals)  
Part No. 141 955 511

The different wirings are illustrated on the drawing. The new push-pull type switch with 3 terminals can also be installed in connection with SWF motors with band brake (previous design), to be recognized by the 3 terminals.

The new SWF wiper motor is set for a higher number of wiper strokes, i.e., 44 strokes per minute as compared with 30 strokes per minute of the previous motor.

SWF with  
permanent magnet

SWF with band brake and  
AVOG with shoe-type brake



## Flasher Units

September 1957

Date introduced from Chassis No.:

|                    |           |
|--------------------|-----------|
| VW Sedan           | 1 621 657 |
| VW Convertible     | 1 532 758 |
| Karmann Ghia Coupé | 1 532 758 |

As of the above specified date all vehicles equipped with flashing type direction indicators will be fitted with a new, shockproof flasher unit, Spare Part No. 141 953 185 B.

**The new arrangement is as follows:**

- 1 - The flasher unit is of cylindrical shape (formerly box-shaped).
- 2 - The ground cable to the flasher unit is no longer required. Instead, the unit is grounded by means of a metal strip held between the flasher unit housing and the holder and connected to the negative (—) terminal.
- 3 - Contrary to the former design, the new flasher unit does not require any warming-up period after being switched on.

The new unit may be exchanged for one of the former design. In this case it will, however, be necessary to lay a ground cable from the negative

(—) terminal of the unit to the steering gear mounting bracket (in the case of the Karmann Ghia Coupé to the left-hand cover hinge stay).

**Attention!**

When installing a flasher unit of the new design in a vehicle of older type, the rubber pad between the flasher unit holder and the steering gear bracket (and in the case of the Karmann Ghia Coupé between the flasher unit holder and the left-hand cover hinge stay) is no longer fitted.

Remember that adequate ground connection is of the utmost importance.

## Blinker Switch

The Karmann Ghia Coupé is provided in current production from Chassis No. 1 649 253 with a self-cancelling blinker switch. Combined with this is a light signal which is operated by lifting the blinker lever toward the steering wheel. The light signal can only be operated with the ignition switched on.

The relay for the light signal is mounted on the back of the instrument panel.

Service installation of the new blinker switch with light signal in vehicles of older version in conjunction with the steering wheel used previously is not possible.

## Semicircle Horn Ring

In connection with the new two-spoke steering wheel (Part No. 141 415 651) of the Karmann Ghia Coupé the horn button previously used has been replaced by a chrome-plated horn ring (Part No. 141 951 551) from Chassis No. 1 649 253.

Service installation of the horn ring is only possible in conjunction with the new steering wheel and the shortened steering column (Part No. 141 415 505). Owing to the shorter steering column, the steering column tube should be pushed downward correspondingly.



## Speedometer and Drive Cable

### General Description

Speedometer and mileage recorder are driven by a cable from the left-hand front wheel. The speedometer is of the eddy-current type operating on the electro-magnetic principles. A ring-shaped magnet is turned round by the speedometer drive shaft. An armature is located within an aluminium cup, which, without touching the magnet, is free to rotate.

The magnetic eddy-currents produced by induction when the armature revolves, cause the cup to rotate together with the speedometer hand shaft which is firmly attached to it. A fine spring is fitted to the upper end of this shaft as a brake, which counteracts the rotations of the cup and shaft, permitting only a predetermined movement of the speedometer hand. Under the braking effect of the spring,

the deflection of the hand becomes greater as the speed of the magnet increases with the speed of the car.

The speedometer unit incorporates a mileage recorder which is driven through a triple worm transmission. Five numeral rolls show the mileage covered by the vehicle.

The speedometer cable consists of several strands of wire and is protected by a flexible metal housing. Should a speedometer cable become defective, a new cable may be inserted in the old metal housing, if the housing has no sharp bends or fractures. This operation should be referred to a VDO Service Station.

## Removing and Installing Speedometer

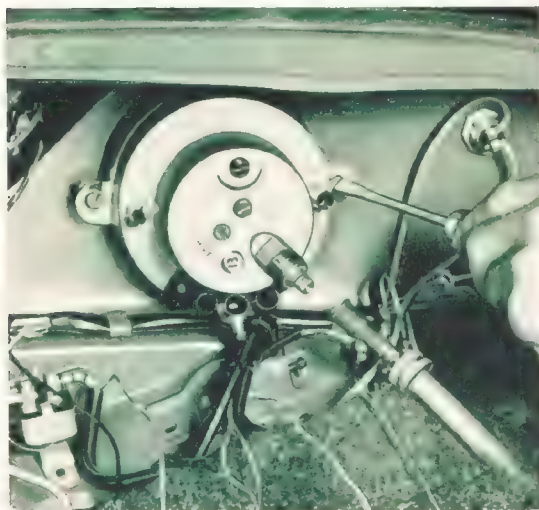
### Removal

- 1 - Remove indicator bulbs and instrument light bulb from the speedometer.
- 2 - Pull out cable at the speedometer by releasing the knurled nut.
- 3 - Remove the two slotted screws that attach the speedometer to the instrument board.

- 4 - Remove speedometer from instrument board.

### Installation

Install the speedometer in the reverse order. Before tightening the slotted screws, make sure that the speedometer is correctly seated so that the figures on the face stand upright.



### Important!

No attempt should be made to alter the mileage indicated or interfere with the mechanism. When replacing or repairing the speedometer, the mileage figure must be the same as that indicated by the speedometer on its removal.

When a replacement must be carried out, the supplier should therefore be given the mileage which was indicated by the old speedometer.

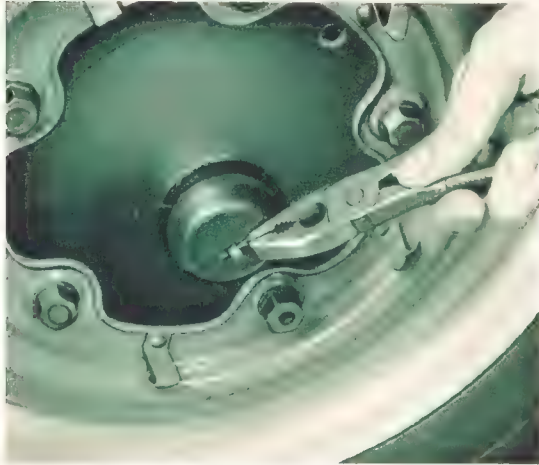
### Note:

Repairs on the guarantee basis are only carried out by VDO Service Stations.

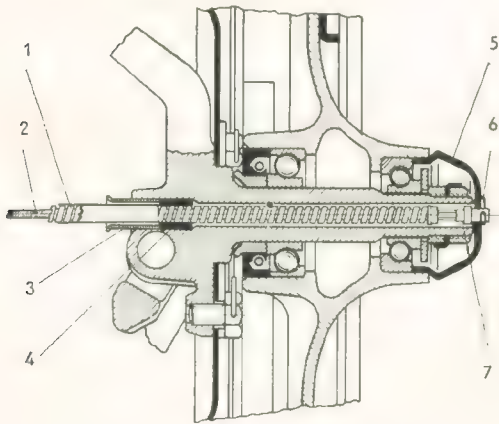
## Removing and Installing Speedometer Cable

### Removal

- 1 - Loosen knurled nut at speedometer.
- 2 - Remove outer hub cap from left-hand front wheel.



- 3 - Remove cotter pin in square end of speedometer cable at hub cap.
- 4 - Pull cable out of the stub axle.
- 5 - Pull cable out of its flexible metal housing.



- 1 - Flexible metal housing
- 2 - Speedometer cable
- 3 - Guide sleeve
- 4 - Rubber sleeve
- 5 - Cap with square hole
- 6 - Cotter pin
- 7 - Cable drive end

### Installation

This is a reversal of the preceding operations, but the following points should be noted:

- 1 - Lubricate cable with Universal Grease VW — A 052.
- 2 - Do not sharply bend or tear the cable.
- 3 - The upper end of the fixed conduit tube should be in line with the connecting piece projecting from the speedometer housing.
- 4 - The upper square end must correctly fit into the square hole in the connecting piece.
- 5 - Install new rubber sleeve in stub axle.
- 6 - Use new cotter pin for securing square end to hub cap.

### Important

Special care should be taken when laying the speedometer cable.

During operation, the cable must not be noisy. The bends of the cable should not be below a radius of 150 mm (6"). With the front wheels in the straight-ahead position, the speedometer cable must run centrally through the fixed conduit tube at the body. There must be not sharp bending or tearing of the cable when turning the wheels from one steering lock to the other. Pressure on the flexible metal housing results in a run-out of the cable which is indicated by an unsteady speedometer hand. If there is a sharp bend, the free movement of the cable is restricted and the cable will break at this point after a short time of operation.

Make sure the rubber sleeve is properly seated in the stub axle. The function of this sleeve is to seal the stub axle unit against splash water, which may lead to bearing trouble and, in frost, to a freezing of the speedometer cable.

Only anti-freeze and water repellent grease should be used as lubricant. Oil is not suitable.

It is recommended to have speedometer cables repaired by VDO Service Stations.

## Fuel Gauge

(Karmann Ghia Models)

With effect from Chassis No. 1 649 253 the Karmann Ghia Coupé is provided with a fuel gauge in current production. The device consists of a panel unit mounted between speedometer dial and clock, and a tank unit.

For service installation the following parts are needed:

| Qty.               | Designation                                   | Part No.      |
|--------------------|-----------------------------------------------|---------------|
| 1                  | Fuel gauge (panel unit)                       | 141 919 031 A |
| 1                  | Tank unit                                     | 111 919 051 A |
| 1                  | Tank unit mounting ring                       | 111 201 141   |
| 1                  | Gasket for tank unit                          | 271 919 125   |
| 5                  | Hex. screws M 5 × 12 DIN 933, galvanized      | N 10 207 1    |
| 5                  | Gaskets A 5 × 9 7603 DIN                      | N 13 802 1    |
| 3 m<br>(3.28 yds.) | Cable 1 mm <sup>2</sup> (.039") cross section | N 17 520 1    |

For service installation details see Technical Bulletin K 8.



## General

The installation of a car radio in the VW Sedan or VW Convertible does not involve any difficulties, as the instrument panel has been designed to allow a service installation of a special car radio. Although the installation of the radio system is greatly facilitated by the manufacturers delivering complete sets and relevant instructions, it is considered advisable to mention the most important points to assure a faultless reproduction at all times. It is recommended to adopt the following procedure for a car radio installation.

- 1 - Install antenna
- 2 - Install speaker
- 3 - Install receiver
- 4 - Install power unit
- 5 - Connection of receiver unit
- 6 - Antenna balance adjustment
- 7 - Suppression equipment

## How to Install Antenna

### General

To obtain a perfect radio reception, the antenna should be as near as possible to the receiver and should occupy a vertical position at a point where the electrical system interference is lowest. The following locations for the antenna are recommended:

ease of pulling out and pushing in the antenna by the driver while the car is in motion (left-hand drive). Additionally, the antenna of a parked car is on this side not exposed to children playing on the side-walk (right-hand traffic). The static produced by the left-hand front wheel, is without much disturbance, picked up by the speedometer cable.

### Side Antenna, Left

The side antenna allows an unobstructed vision through the windshield. Another advantage is the

### Side Antenna, Right

The distance to the receiver is shorter than on the left-hand side. The wheel static may be stronger, since the electricity is not picked up by the speedometer cable as at the left-hand wheel.



### Center Antenna

The center antenna insures a most favourable radio reception, as it is nearest to the receiver. The relatively long distance to the front wheels reduces the adverse effect of wheel static, and fluctuations of the magnetic field when driving on super-highways are less perceptible.

Disadvantageous is the obstruction of vision by the antenna bar in the center of the windshield. As the antenna is difficult to reach from the side of the car, it is often omitted to push it in. The antenna is likely to break when passing through low doorways.

## Other Antennae

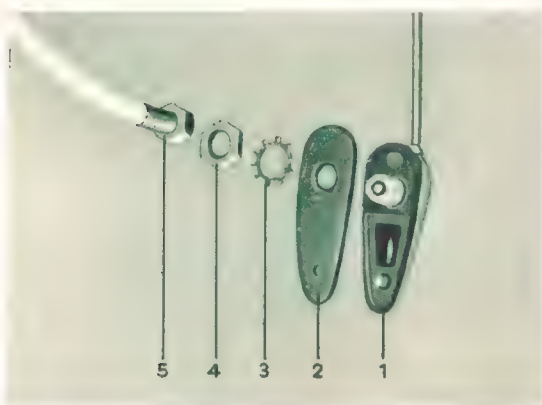
Antennae located underneath the car and those fitted over the roof by using several insulated brackets, or those which are sewn in the top of Convertibles, are susceptible to static interference and are generally responsible for a weak reception.

## Installation

### Note:

It is recommended to remove the spare wheel and the front luggage compartment lining prior to installing the antenna.

- 1 - Drill the holes for the antenna mounting, using a drill jig if possible.
- 2 - Scrape off the paint from the inside around the large hole to assure that the antenna lead screen is perfectly grounded.
- 3 - Place rubber gasket on the antenna foot and insert the threaded terminal and the locating pin, if present, in the holes.



- |                              |                        |
|------------------------------|------------------------|
| 1 - Antenna foot and antenna | 3 - Shake-proof washer |
| 2 - Rubber gasket            | 4 - Nut                |
|                              | 5 - Union nut          |

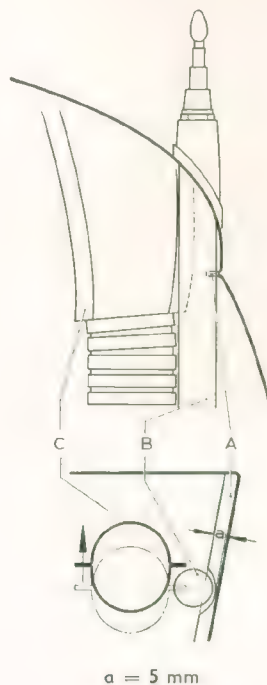
- 4 - Place shake-proof washer on the threaded terminal projecting into the luggage compartment and tighten the nut.

- 5 - Insert the antenna lead connector into the antenna foot terminal and tighten union nut.

### Note:

The installation of telescope antennae in Passenger Cars from Chassis No. 1 - 0 931 501 can only be carried out in connection with the following two modifications:

- 1 - File a radius (A)  $a = 5$  mm (19") into the front side panel flange in the left-hand rear corner of the luggage compartment for the antenna (B).
- 2 - Bend the left-hand windshield defroster duct (c) rearward by a few millimeters to allow the antenna (B) to pass through.



## Speaker Installation

## Installation

- 1 - Remove the rubber boots from the back of the instrument panel, turn up the retaining tongues

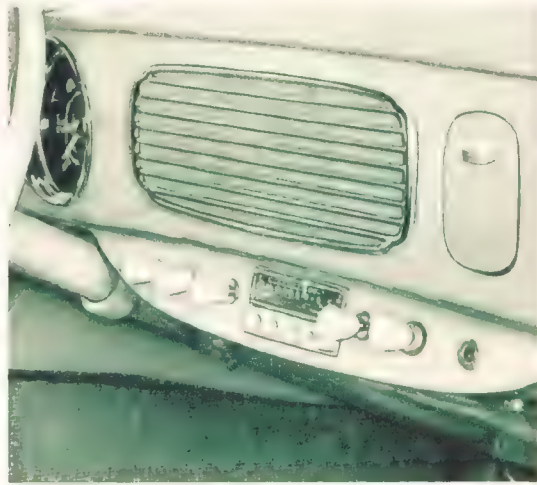
of the ornamental speaker grille and take off speaker grille and gauze. Remove the screws that attach the speaker opening cover plate.

- 2 - Attach speaker and packing ring to the opening, using four cylindrical screws M 3. Make sure the two sockets, if present, for an extension speaker are easily accessible. The screw heads must be concealed behind the speaker grille.
- 3 - Attach the grille and gauze to the instrument panel by twisting the retaining tongues. Cement the six rubber boots in place.



## Receiver Installation

- 1 - Take off "dial" opening cover plate after having removed the two nuts accessible from the luggage compartment.
- 2 - Insert one escutcheon plate each in the two holes for the control knobs.
- 3 - Remove the two control knobs from the receiver.
- 4 - Insert receiver in the opening in the instrument panel. Place retainer against the back face of the receiver and mark the holes for the mounting screws on the luggage compartment panel.
- 5 - Remove receiver, mark the holes with a center punch and drill by means of a 6.5 mm diam. (.26") drill.
- 6 - Place the rubber gasket around the radio "dial" rim and reinstall the receiver. Place retainer against receiver back face and screw it in position. If necessary, interpose felt strips between retainer and receiver. Use shims to bring the receiver into line with the opening in the instrument panel.
- 7 - Screw the control knobs in position.





## Vibrator Installation

### General

The best location for the vibrator unit is on the level surface behind the spare wheel. Should it not be possible to accommodate the vibrator in the spare wheel compartment, it is recommended to install it in the front luggage compartment. It is of paramount importance that the vibrator is perfectly grounded.

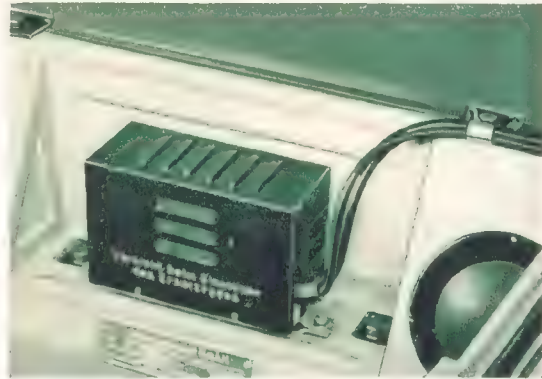
3 - Scrape off the paint from the area where the retainer makes contact with the level panel to assure that the vibrator is perfectly grounded.

4 - Attach retainer by means of the two bolts and nuts M 8 to the body. Attach vibrator to the retainer by means of the screws.

### Installation (Spare Wheel Compartment)

1 - Place vibrator unit and retainer on the level surface of the spare wheel compartment so that the front edge of the unit is flush with the front edge of the level surface. The model detail plate must not be concealed in any way. It is considered expedient to attach the model plate to the inclined surface below the vibrator unit.

2 - Mark the holes for the mounting screws and drill 8.55 mm diam. (.33") holes into the level plate.



## Connecting Receiver Unit

### Attention!

Switch off the radio before connecting or disconnecting the speaker as there is a tension of 250 volts at the terminals.

short-circuit will occur when trying to connect the cables in another manner.

1 - Remove rubber sleeve from the connector and connect the three-strand cable of the speaker to the cable of the receiver. The ends of the screen strands must oppose each other. After the cable ends have been connected, replace the rubber sleeve over the connector.

2 - Connect the vibrator cable with receiver cable by means of the plug and socket shown in the illustration. Take care that the projection engages with the corresponding groove. A



3 - Connect the battery cable of the receiver to the fuse terminal for the interior light (Fuse box for four fuses situated in front luggage compartment).

4 - Insert antenna lead plug in the antenna socket at the receiver.

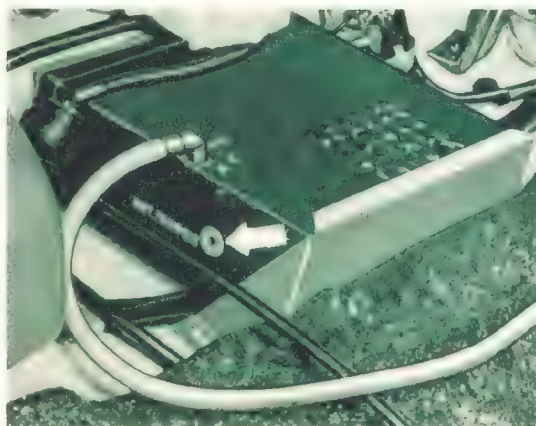
## Antenna Balance Adjustment

### General

After the radio installation is completed, the antenna circuit of the radio should be balanced with the receiver installed on the vehicle.

### Balance Adjustment

- 1 - Drive the vehicle under a viaduct or a suitable partially shielded location where reception will be diminished sufficiently to make the test.
- 2 - Tune in on a station on or near the 600 Kilocycle frequency.
- 3 - Adjust the speaker to peak volume at the antenna adjustment screw in the receiver (arrow).



## Suppression Equipment

The car radio has to meet special requirements. It is to give faultless reproduction with a relatively short antenna. The car radio is therefore necessarily sensitive and may consequently pick up electrical system interference of the vehicle. The use of condensers and suppressors will generally provide the necessary shielding for suppression of electrical disturbances so that the quality and volume of reception will be normal and satisfactory, provided there is no irregularity in the receiver or antenna circuits. Disturbances may also be caused by poor ground, loose connections, or wheel static. When inspecting the radio installation, special attention should be paid to the ground connections. To suppress the electrical system, the following parts are required:

4 Spark plug connectors 10 K  $\Omega$

1 Suppressor sleeve 10 K  $\Omega$

2 Screening condensers 2.5  $\mu$  F

After the electrical system disturbances have been suppressed, turn the radio on for reception with engine running. Should any interference still be present, recheck the electrical system shielding and

make sure the wires are making good connection. If the trouble cannot be located by the above procedure, the radio should be removed from the car and turned over to a radio serviceman.

### Suppressing Ignition System

#### a - Spark Plugs

Replace the spark plug connectors by the four shielded connectors. Make sure the connectors make perfect contact with the cable cores.

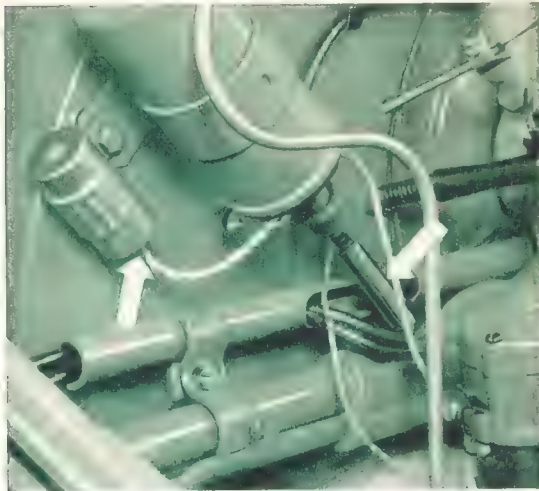
#### b - Ignition Cable

Install suppressor sleeve in the cable between ignition coil and distributor, taking care that the sleeve is nearer to the distributor than to the coil.

#### c - Ignition Coil

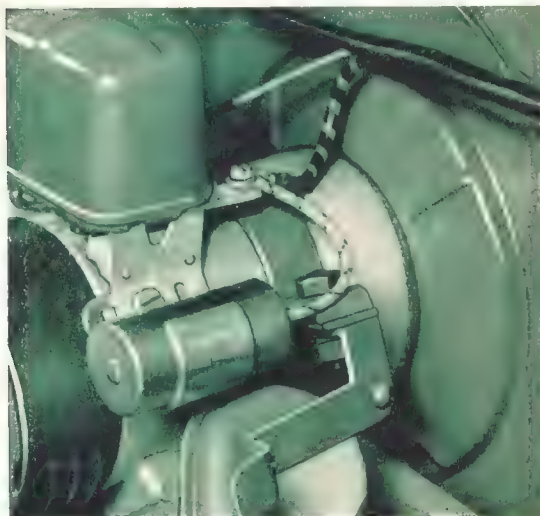
- 1 - Connect screening condenser 2.5  $\mu$  F to terminal 15 of the ignition coil.

- 2 - Attach condenser retainer to the fan housing by means of the ignition coil mounting screw. Make sure there is a good ground connection.



#### Suppressing Generator

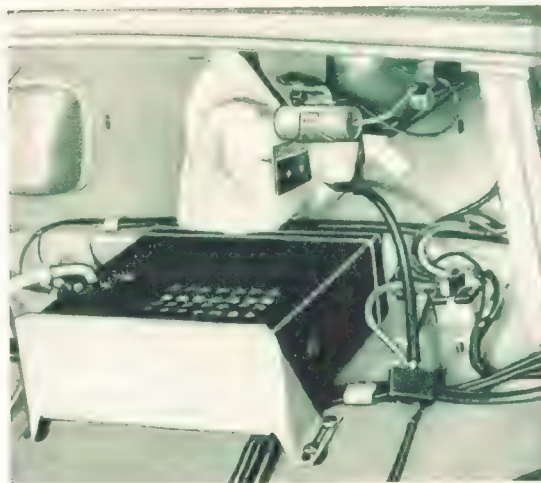
- 1 - Connect cable of screening condenser  $2.5 \mu F$  to terminal 51 of the regulator.



- 2 - Attach condenser retainer to the generator by means of the regulator mounting screw. Make sure there is a good ground connection.

#### Suppressing Windshield Wiper Motor

- 1 - Connect cable of screening condenser  $2.5 \mu F$  to positive terminal (30) of the windshield wiper motor.



- 2 - Attach the condenser retainer by means of the wiper motor mounting screw. Make sure there is a good ground connection.

#### Note:

For details on the suppression of the electrical system when installing a car radio with ultra short wave length, reference should be made to the instructions furnished by the manufacturers with each radio set.

If there is still an occasional noise in the radio when the car is in motion, it is probably due to wheel static caused by the front wheel bearings. Wheel static collectors are available for installation on the wheels to ground the wheel components to the car frame.

## Resistor Type Spark Plug Connectors

In most cases, occasional ignition failure in screened engines is caused by resistor type spark plug connectors.

May we, therefore, point out that the following types only are suited for installation in VW Passenger Cars and Transporters:

BOSCH EM/W 10/24 (Spare Part No.  
113 035 255 A)

BERU BE 4/10

Furthermore, the suppressor sleeves formerly fitted between ignition distributor and ignition coil of BOSCH or BERU make may no longer be used. Instead, the following distributor rotors with built-in resistor are to be used exclusively:

BOSCH ZVVT 5 Z 5 Z (Spare Part No.  
111 905 225 C)

BERU EVL 4/6





## Minimizing the voltage drop

### Ground strap connections at chassis and body

To minimize the voltage drop at the ground strap connections on VW Passenger Cars, the following modifications have been introduced from Chassis No. 1 109 359:

- 1 - Battery ground strap fixing screw galvanized.
- 2 - Lockwasher for battery ground strap fixing screw galvanized.
- 3 - Washer for battery ground strap fixing screw galvanized.
- 4 - The anchor nut in the frame is retapped prior to installation of battery ground strap to remove any traces of paint.
- 5 - No sealing compound is applied to the body sealing strip at the point where the ground strap is connected.
- 6 - The reinforcement angle at the hole for the battery ground strap fixing screws is galvanized where it makes contact with the strap. This contact surface should be scraped blank whenever a repainting job has been carried out.
- 7 - The two nuts for the studs attaching the transmission front rubber cushion to the frame are galvanized.
- 8 - The two lockwashers for the above nuts are galvanized.
- 9 - The frame studs are also galvanized. The threads are cleaned of all traces of paint.

Should an excessive voltage drop or difficult starting occur, check the aforementioned ground strap connections and, if found necessary, thoroughly clean the contact surfaces. The galvanized nuts, screws, and washers can be subsequently installed on all cars of earlier production.

### Main Harness

From Chassis No. 1 278 049 the cross section of cable 15 from ignition starting switch to ignition coil has been increased from 0.75 sq. mm (.001 sq. inch.) to 1.5 sq. mm (.002 sq. inch.) in connection with the introduction of the new ignition coil TE 6 B 1.

The part number of the main harness remains unchanged.

A service installation of the thicker cable (1.5 sq. mm (.002 sq. inch.)) is possible after having removed the headlining, as the headlining support wires make this job difficult to carry out. Cut off the disconnected ends of the old cable (0.75 sq. mm) (.001 sq. inch.) in the main harness.

### Battery Ground Strap

From Chassis No. 1 329 174 the battery ground strap is no longer attached to one of the body mounting bolts, but is clamped to the frame cross member with a separate bolt. The cross member is provided with a hole and a welded-on nut. The new ground strap is attached by means of a bolt, a washer and a lock washer. The point of contact at the cross member is cleaned to the bare metal.

## Starter Cable (Karmann Ghia Models)

At routine servicing and whenever disconnecting and connecting the starter cable, it should be made a point to check the rubber grommet in the hole where the cable is routed through the luggage compartment panel.

As the grommet is a tight fit on the cable, it is possible that the grommet becomes dislodged from its seat in the panel by an improper installation of the cable or a heavy pull, leading to leaks and damage to the cable.

## Main Harness

In connection with the new instrument panel the length of the main harness cables has been altered on VW Passenger Cars from Chassis No. 1 600 440. The main harness is no longer housed in the RH roof member but in that on the left. This makes it necessary to install a separate harness from the generator to the starting motor.

The new main harness (Part No. 111 971 011 F, for RH drive 112 971 011 D, for sealed-beam headlamps 111 971 013 B) and the new harness between generator and starting motor (Part No. 111 971 127) can only be installed in Passenger Cars from August 1957 onwards.

Harnesses for cars of previous design will still be available.



# Workshop Equipment

# E

## 1 - VW Special Service Tools

|        |                            |
|--------|----------------------------|
| VW 159 | Oil Pressure Switch Wrench |
| VW 246 | Not-go Plug Gage           |

## 2 - VW Workshop Equipment for Local Manufacture

|        |                            |
|--------|----------------------------|
| VW 654 | Scale for Timing Light     |
| VW 662 | Oil Pressure Switch Tester |

## 3 - Normal Hand Tools

Electrician's Screwdriver, 3 mm  
Screwdriver, 6 mm  
Combination pliers  
Cutting pliers  
Prick Punch (center punch)  
Mechanic's hammer, 300 grams  
Triangular scraper  
Flat file, 180 mm in length  
Round file, 180 mm in length  
Half-round file, 180 mm in length  
Phillips screwdriver, 3 mm  
Open-end wrench, 6 mm  
Open-end wrench, 9 mm  
Open-end wrench, 10 mm  
Open-end wrench, 17 mm  
Box wrench, 17 mm  
Wire brush  
Oil-can  
Can for derusting fluid  
Grease container  
Scratch awl  
Test lamp, 6 volts  
Contact file  
Feeler gauge, 0.1—0.5 mm  
Caliper square, 300 mm in length, measuring 1/50 mm  
Tap M 6  
Tap wrench, size 1, adjustable  
Die M 6  
Die stock, size 1  
Drill, 5.0 mm  
Drill, 7.0 mm  
Inspection lamp with cable and plug  
Electric drill

## 4 - Other Workshop Equipment

Hydrometer  
Voltmeter  
Spark plug cleaner and tester  
Distributor test stand  
Headlight aiming and testing device  
Amperemeter and voltmeter





## Contents:

**1 - Lubrication and Maintenance Chart**

**2 - Tools and Appliances**

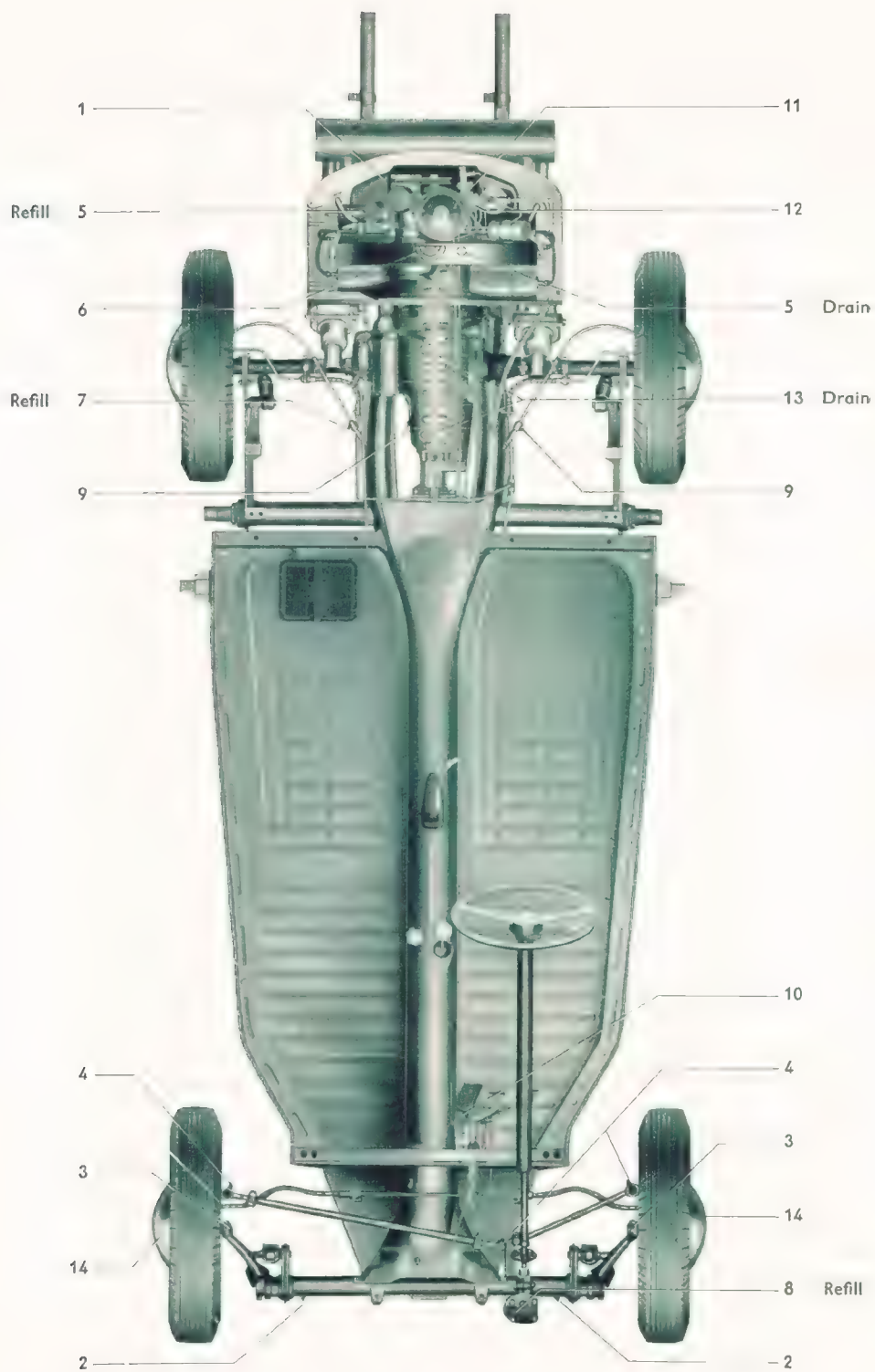


# Maintenance Chart

(From June 1956)

S

| At km/miles<br>km miles<br>500 300<br>2500 1500<br>5000 3000 | Operation                                                                                                                    | Every                             |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
|                                                              | Clean air cleaner                                                                                                            | 5000<br>km<br><br>3000<br>miles   |
|                                                              | Check and adjust fan belt                                                                                                    |                                   |
|                                                              | Clean carburetor<br>Check carburetor adjustment                                                                              |                                   |
|                                                              | Check breaker points and ignition timing                                                                                     |                                   |
|                                                              | Check valve clearance                                                                                                        |                                   |
|                                                              | Examine battery                                                                                                              |                                   |
|                                                              | Check operation of lights, signals, and instruments                                                                          |                                   |
|                                                              | Check generator                                                                                                              |                                   |
|                                                              | Check spark plugs and compression                                                                                            |                                   |
|                                                              | Check steering gear adjustment                                                                                               |                                   |
|                                                              | Check front wheel bearings, front suspension, tie rod ends and toe-in                                                        |                                   |
|                                                              | Check tire pressures and tighten wheel bolts<br>From 5000 km (3000 miles) onwards, rotate tires                              |                                   |
|                                                              | Test brakes and check brake fluid level<br>Check brake linings through inspection hole                                       |                                   |
|                                                              | Check tightness and effect of shock absorbers                                                                                |                                   |
|                                                              | Check clutch pedal clearance                                                                                                 |                                   |
|                                                              | Coat weather strips for doors and Convertible windows with powdered talc                                                     |                                   |
|                                                              | Check automatic cooling air control                                                                                          |                                   |
|                                                              | Inspect rear axle and engine for oil leaks                                                                                   |                                   |
|                                                              | Engine, especially exhaust, carburetor, intake manifold, and fuel pump<br>Chassis, body, front axle, rear axle, and steering | Check tightness of nuts and bolts |



**Lubrication Points**  
(Chassis)





# Lubrication Chart

(From June 1956)

S

| At km miles                                   | No. | Lubrication points                           | Lubricant | Every                     |
|-----------------------------------------------|-----|----------------------------------------------|-----------|---------------------------|
| km miles<br>500 300<br>2500 1500<br>5000 3000 |     |                                              |           |                           |
|                                               | ①   | Engine: Check oil level, top up if necessary | (M)       | 2500 km<br>1500 miles     |
|                                               | ②   | Front axle tubes                             | (F)       |                           |
|                                               | ③   | King pins                                    | (F)       |                           |
|                                               | ④   | Tie rod ends                                 | (F)       |                           |
|                                               |     | Door hinges                                  | (M)       | 5000 km<br>3500 miles     |
|                                               | ⑤   | Engine: Change oil                           | (M)       |                           |
|                                               | ⑥   | Engine: Clean oil strainer                   |           |                           |
|                                               | ⑦   | Transmission: Check oil level                | (G)       |                           |
|                                               | ⑧   | Steering gear: Check oil level               | (G)       |                           |
|                                               | ⑨   | Brake cables                                 | (F)       |                           |
|                                               | ⑩   | Pedal cluster                                | (F)       |                           |
|                                               | ⑪   | Carburetor controls                          | (M)       |                           |
|                                               | ⑫   | Breaker arm fiber block in distributor       | (F)       | 25 000 km<br>15 000 miles |
|                                               |     | Door and hood locks                          | (F)       |                           |
|                                               |     | Convertible: Top linkages                    | (M)       |                           |
|                                               | ⑬   | Transmission: Change oil                     | (G)       |                           |
|                                               | ⑭   | Front wheel bearings                         | (W)       |                           |
|                                               | ⑮   | Cam bearing in distributor                   | (M)       |                           |

## Lubricants

| Lubricant        | Lubrication points                                                                                                                                                   | Specifications |         |                                     |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------|-------------------------------------|
|                  |                                                                                                                                                                      | Temperature    |         |                                     |
|                  |                                                                                                                                                                      | C              | F       |                                     |
| Engine           | Engine, air cleaner, carburetor controls, door hinges, cam bearing in distributor, Convertible: Top linkages                                                         | (M) above      | +30 +86 | SAE 30                              |
|                  |                                                                                                                                                                      | from           | 0 +32   | SAE 20 or                           |
|                  |                                                                                                                                                                      | to             | +30 +86 | SAE 20W                             |
|                  |                                                                                                                                                                      | below          | 0 +32   | SAE 10W                             |
|                  |                                                                                                                                                                      | below          | -25 -13 | SAE 5W                              |
| Gear oil         | Transmission case, Steering gear                                                                                                                                     | (G) above      | 0 +32   | SAE 90                              |
|                  |                                                                                                                                                                      | below          | 0 +32   | SAE 80                              |
|                  |                                                                                                                                                                      | (G)            |         | SAE 90                              |
| Universal grease | Front axle, tie rod ends, front wheel bearings, brake cables, pedal cluster, gearshift lever, breaker arm fiber block, door and hood locks, Convertible: Door hinges | (F)            |         | Anti-freeze, water-repellent grease |
| Special grease   | Front wheel bearing                                                                                                                                                  | (W)            |         | High melting point grease           |



# Tools and Appliances

# S

## 1 - VW Special Service Tools

|         |                              |
|---------|------------------------------|
| VW 102  | T-Wrench, 14 mm              |
| VW 103  | T-Wrench, 17 mm              |
| VW 106  | T-Wrench, 10 mm              |
| VW 113  | Two Open End Wrenches, 27 mm |
| VW 113a | Two Open End Wrenches, 32 mm |
| VW 126a | Fuel Pump Wrench             |
| VW 163a | 36 mm Socket                 |
| VW 266f | Tie Rod End Remover          |

## 2 - VW Workshop Equipment for Local Manufacture

|        |                                      |
|--------|--------------------------------------|
| VW 637 | Inner and Outer Hub Cap Removal Tool |
|--------|--------------------------------------|

## 3 - Normal Hand Tools

Electrician's screwdriver, 3 mm  
Screwdriver, 6 mm  
Screwdriver, 8 mm  
Carburetor screwdriver  
Combination pliers  
Pipe wrench  
Cold chisel  
Mechanic's hammer, 300 grams  
Mechanic's hammer, 500 grams  
VW Spark plug wrench  
Socket wrench, 14 mm  
Socket wrench, 17 mm  
Phillips screwdriver, 3 mm  
Phillips screwdriver, 5 mm  
Open-end wrench, 7 mm  
Open-end wrench, 8 mm  
Open-end wrench, 10 mm  
Open-end wrench, 12 mm  
Open-end wrench, 14 mm  
Open-end wrench, 19 mm  
Open-end wrench, 22 mm  
Box wrench, 14 mm  
Box wrench, 17 mm  
Box wrench, 19 mm  
Box wrench, 27 mm  
Box wrench, 30 mm  
Box wrench, 36 mm  
Wire brush  
Oil-can  
Can for derusting fluid  
Grease container  
Test lamp, 6 volts  
Contact file  
Air pressure gauge, 0—6 kg/cm<sup>2</sup> (85 lbs./sq. in.)  
Set of feeler gages, 0.1—0.5 mm  
Torque wrench, 0—30 mkg (217 ft. lbs.)  
Inspection lamp with cable and plug

## 4 - Supplementary Workshop Equipment





## Fuel System

|                                          |                                                          |
|------------------------------------------|----------------------------------------------------------|
| Carburetor .....                         | Downdraught, SOLEX 28 PCI, with accelerator pump         |
| Venturi .....                            | 20 mm                                                    |
| Main jet .....                           | 105                                                      |
| Pilot jet .....                          | 50                                                       |
| Pilot jet air bleed .....                | 0.8 mm                                                   |
| Air correction jet .....                 | 190                                                      |
| Emulsion tube .....                      | 10                                                       |
| Float needle valve .....                 | 1.5                                                      |
| Float, weight .....                      | 12.5 g (.44 oz.)                                         |
| Pump jet .....                           | 50                                                       |
| Pump air correction jet .....            | 2.0                                                      |
| Air cleaner .....                        | Felt cone type, oil-bath type in dusty areas             |
| Fuel pump .....                          | SOLEX diaphragm type                                     |
| Feeding pressure .....                   | 0.09 to 0.13 atm. (1.28 to 1.85 lbs./sq. in.)            |
| Fuel delivery via float needle valve ... | min. 10 l/h. (approx. 2.5 gals.) at 3000 engine r. p. m. |
| Fuel filter .....                        | Strainer and water excluder at fuel tap                  |

## Electrical System

|                                         |                                           |
|-----------------------------------------|-------------------------------------------|
| Electrical system .....                 | 6 V with voltage regulator                |
| Battery .....                           | 6 V 70 ampere hours                       |
| Generator .....                         | Bosch RED 130/6—2600 AL 16                |
| Regulator .....                         | Bosch RS/G 130/6/11 on generator          |
| Ratio, cranksh. — Generator shaft ..... | Approx. 1 : 2                             |
| Generator commences to charge .....     | At approx. 1800 r. p. m. of the generator |
| Starter motor .....                     | Bosch EED 0.4/6 L 4                       |

## Transmission Final and Drive

|                    |                                                                                          |
|--------------------|------------------------------------------------------------------------------------------|
| Transmission ..... | 4 speeds forward, 1 reverse                                                              |
| De Luxe .....      | 2nd, 3rd and 4th gears helically-cut and silent, provided with cone-type synchro-devices |
| Gear ratios .....  | First 3.60 : 1                                                                           |
|                    | Second 1.88 : 1                                                                          |
|                    | Third 1.22 : 1                                                                           |
|                    | Fourth 0.79 : 1                                                                          |
|                    | Reverse 4.63 : 1                                                                         |
| Standard .....     | 3rd and 4th gear helically-cut and silent                                                |
| Gear ratios .....  | First 3.60 : 1                                                                           |
|                    | Second 2.07 : 1                                                                          |
|                    | Third 1.25 : 1                                                                           |
|                    | Fourth 0.80 : 1                                                                          |
|                    | Reverse 6.60 : 1                                                                         |
| Gear control ..... | Manually through linkage, ball-type shift lever on frame tunnel                          |
| Final drive .....  | Helically-cut drive pinion and ring gear, bevel type differential, swinging half axles   |
| Ratio .....        | 4.43 : 1 (Klingelnberg)                                                                  |
|                    | 4.37 : 1 (Gleason)                                                                       |

## Chassis

|                                              |                                                                                                                        |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Frame .....                                  | Central tubular backbone with large head for mounting the front axle, forked at the rear to accommodate the power unit |
| Wheel suspension: front .....                | Independent, two longitudinal torsion arms on either side                                                              |
| rear .....                                   | Independent, swinging half axles, one longitudinal spring plate on either side                                         |
| Spring: front .....                          | Two square torsion bar springs of 6 steel bands each                                                                   |
| rear .....                                   | One round torsion bar on each side                                                                                     |
| Adjustment of rear torsion bars, unloaded .. | $13^{\circ} \pm 30'$ inclination of the spring plate                                                                   |
| Shock absorbers: front and rear .....        | Double acting, telescopic                                                                                              |
| Steering .....                               | Worm and sector gear with divided tie rod                                                                              |
| Total ratio .....                            | 14.15                                                                                                                  |
| Turns of steering wheel, lock to lock .....  | 2.4                                                                                                                    |
| Smallest turning circle .....                | About 11 m (36 ft.)                                                                                                    |
| Toe-in (car unladen) .....                   | 1—3 mm (0.04'' to 0.12'')                                                                                              |
| Camber .....                                 | $0^{\circ}40' \pm 30'$                                                                                                 |
| King pin inclination .....                   | $4^{\circ}20'$                                                                                                         |
| Caster (front axle tubes) .....              | $2^{\circ}30' \pm 30'$                                                                                                 |
| Wheels .....                                 | Disc wheels with drop-center rims 4 J x 15                                                                             |
| Tires .....                                  | 5.60—15                                                                                                                |
| Tire pressures                               |                                                                                                                        |
| 1—2 Occupants .....                          | Front 1.1 atm. (16 lbs./sq. in.)                                                                                       |
|                                              | Rear 1.4 atm. (20 lbs./sq. in.)                                                                                        |
| 3—4 Occupants .....                          | Front 1.2 atm. (17 lbs./sq. in.)                                                                                       |
|                                              | Rear 1.6 atm. (23 lbs./sq. in.)                                                                                        |
| Brakes                                       |                                                                                                                        |
| De Luxe: foot brake .....                    | Hydraulic (Ate), acting on all wheels                                                                                  |
| hand brake .....                             | Mechanical, acting on rear wheels                                                                                      |
| Standard: foot brake .....                   | Mechanical, acting on all wheels                                                                                       |
| hand brake .....                             | Mechanical, acting on all wheels                                                                                       |
| Braking area: front .....                    | 260 sq. cm (40.3 sq. ins.)                                                                                             |
| rear .....                                   | 260 sq. cm (40.3 sq. ins.)                                                                                             |
| Lubrication system .....                     | Single lubrication points                                                                                              |

## Dimensions and Weights

|                                        |                           |
|----------------------------------------|---------------------------|
| Wheel base .....                       | 2400 mm (7 ft. 10.5 ins.) |
| Track: front .....                     | 1290 mm (4 ft. 3 ins.)    |
| rear .....                             | 1250 mm (4 ft. 1.2 ins.)  |
| Length .....                           | 4070 mm (13 ft. 4 ins.)   |
| Width .....                            | 1540 mm (5 ft. 1/2 in.)   |
| Height .....                           | 1500 mm (4 ft. 11 ins.)   |
| Smallest ground clearance with the car |                           |
| fully laden .....                      | 172 mm (6.8 ins.)         |
| Angle of approach .....                | $25^{\circ}$              |
| Angle of departure .....               | $13^{\circ}30'$           |

|                               |    | Sedan | Sedan with<br>sunshine roof | Convertible<br>4-seater |
|-------------------------------|----|-------|-----------------------------|-------------------------|
| Net weight .....              | kg | 710   | 710                         | 780                     |
| Weight, ready for use .....   | kg | 730   | 730                         | 800                     |
| Maximum load .....            | kg | 380   | 380                         | 360                     |
| Total weight .....            | kg | 1110  | 1110                        | 1160                    |
| Max. load on front axle ..... | kg | 450   | 450                         | 480                     |
| Max. load on rear axle .....  | kg | 660   | 660                         | 680                     |
| Weight of chassis .....       | kg | 435   | 435                         | 435                     |

# Capacity

|                            |                                                                          |
|----------------------------|--------------------------------------------------------------------------|
| Fuel tank .....            | 40 liters, including 5 liters reserve (10.5 U. S. Gals.; 8.8 Imp. Gals.) |
| Crankcase .....            | 2.5 liters (5.3 U. S. pints; 4.4 Imp. pints)                             |
| Transmission case .....    | 2.5 liters (5.3 U. S. pints; 4.4 Imp. pints)                             |
|                            | Refilling quantity: 2 liters (4.2 U. S. pints; 3.5 Imp. pints)           |
| Steering .....             | 0.125 liter (0.26 U. S. pint; 0.22 Imp. pint)                            |
| Brake .....                | 0.25 liter (0.5 U. S. pint; 0.4 Imp. pint)                               |
| Oil bath air cleaner ..... | 0.25 liter (0.5 U. S. pint; 0.4 Imp. pint)                               |

# Performance

|                                  |                                                    |
|----------------------------------|----------------------------------------------------|
| Performance .....                | 25 BHP at 3300 r. p. m.                            |
| Max. torque .....                | 7 mkg (51 ft. lbs.) at 2000 r. p. m.               |
| Average piston speed .....       | 6.42 meters per second (1263 ft.) at 3000 r. p. m. |
| Maximum and cruising speed ..... | 100 km p. h. (62 miles) at 3000 r. p. m.           |

Speeds at 3000 r. p. m.

|                 | De Luxe                          | Standard                 |
|-----------------|----------------------------------|--------------------------|
| 1st speed ..... | approx. 22 km. p. h. (14 miles)  | 22 km. p. h. (14 miles)  |
| 2nd speed ..... | approx. 42 km. p. h. (26 miles)  | 38 km. p. h. (24 miles)  |
| 3rd speed ..... | approx. 65 km. p. h. (40 miles)  | 63 km. p. h. (39 miles)  |
| 4th speed ..... | approx. 100 km. p. h. (62 miles) | 100 km. p. h. (62 miles) |
| Reverse .....   | approx. 16 km. p. h. (10 miles)  | 12 km. p. h. (7 miles)   |

Hill climbing ability (car laden with two persons, on normal road)

|                 | De Luxe              | Standard     |
|-----------------|----------------------|--------------|
| 1st speed ..... | approx. 33 % (18.5°) | 33 % (18.5°) |
| 2nd speed ..... | approx. 16 % (9°)    | 18 % (10°)   |
| 3rd speed ..... | approx. 9.5 % (5.5°) | 9.5 % (5.5°) |
| 4th speed ..... | approx. 5 % (3°)     | 5 % (3°)     |

# Fuel Consumption

|                                          |                                                                                       |
|------------------------------------------|---------------------------------------------------------------------------------------|
| Average fuel consumption on normal roads | metric: 7.5 liters per 100 km. (U. S.: 32 miles per gallon; Imp: 38 miles per gallon) |
| Fuel .....                               | 74 Octane (Res. F 1)                                                                  |
| Oil consumption .....                    | Between 0.03 and 0.1 liter per 100 km                                                 |



## Engine

|                                                           |                                                                                                                         |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Design .....                                              | 4-cycle, internal-combustion engine in unit with clutch, transmission and differential in rear of car                   |
| Number of cylinders .....                                 | 4                                                                                                                       |
| Arrangement of cylinders .....                            | Two pairs horizontally opposed (flat four)                                                                              |
| Bore .....                                                | 77 mm (3.031'')                                                                                                         |
| Stroke .....                                              | 64 mm (2.520'')                                                                                                         |
| Capacity .....                                            | 1192 c. c. (72.74 cu. ins.)                                                                                             |
| Compression ratio .....                                   | 6.1                                                                                                                     |
| Total weight, dry .....                                   | Approx. 90 kg (198 lbs.)                                                                                                |
| Cylinders .....                                           | Single cylinders of special grey cast iron                                                                              |
| Cylinder head .....                                       | One for two cylinders, light alloy                                                                                      |
| Crankshaft .....                                          | Forged, 4 bearings                                                                                                      |
| Main bearings, 1, 3 and 4 .....                           | Precision-insert bushings                                                                                               |
| Main bearing 2 (center) .....                             | Precision-insert shells                                                                                                 |
| Connecting rod bearings .....                             | Lead-bronze, steel-backed                                                                                               |
| Piston pin bearing .....                                  | Pressed-in bronze bushing                                                                                               |
| Piston .....                                              | Light metal with steel reinforcement                                                                                    |
| Piston rings .....                                        | 2 compression rings<br>1 oil ring                                                                                       |
| Valve actuating mechanism .....                           | 1 camshaft situated below crankshaft, valves operated via push rods and rocker arms                                     |
| Camshaft .....                                            | Cast, 3 bearings machined in crankcase                                                                                  |
| Camshaft drive .....                                      | Helical gears                                                                                                           |
| Valve arrangement .....                                   | Overhead                                                                                                                |
| Valve clearance, intake .....                             | 0.10 mm (.004'')                                                                                                        |
| exhaust .....                                             | 0.10 mm (.004'')                                                                                                        |
|                                                           | } in cold condition of engine                                                                                           |
| Valve timing (with a valve clearance of 1 mm/.04'') ..... |                                                                                                                         |
| Intake opens .....                                        | 2° 30' before T. D. C.                                                                                                  |
| Intake closes .....                                       | 37° 30' after B. D. C.                                                                                                  |
| Exhaust opens .....                                       | 37° 30' before B. D. C.                                                                                                 |
| Exhaust closes .....                                      | 2° 30' after T. D. C.                                                                                                   |
| Cooling system .....                                      | Air cooling by fan on generator shaft                                                                                   |
| Fan drive .....                                           | From crankshaft through V-belt                                                                                          |
| Cooling air intake .....                                  | Thermostat-controlled                                                                                                   |
| Amount of cooling air .....                               | 18 cubic feet per second at 3300 engine r. p. m.                                                                        |
| Lubrication .....                                         | Pressure feed lubrication by gear pump                                                                                  |
| Oil cooling .....                                         | Oil cooler situated in air stream                                                                                       |
| Oil pressure control .....                                | By warning light                                                                                                        |
| Ignition .....                                            | Battery ignition                                                                                                        |
| Ignition coil .....                                       | Bosch TE 6 A 3                                                                                                          |
| Ignition distributor .....                                | Bosch VJU 4 BR 3 mk (or Tmk*) with vacuum advance                                                                       |
| Spark timing .....                                        | 7° 30' before T. D. C.                                                                                                  |
| Firing order .....                                        | 1—4—3—2                                                                                                                 |
| Spark advance .....                                       | By centrifugal and vacuum mechanism                                                                                     |
| Breaker point gap .....                                   | 0.4 mm (.016'')                                                                                                         |
| Spark plugs .....                                         | 14 mm thread, heat range 175<br>Bosch W 175 T 1 and T 1 A<br>Beru K 175/14 u 2<br>Lodge HD 14<br>Champion L 10<br>AC 44 |
| Spark plug gap .....                                      | 0.6—0.7 mm (.024'' to .028'')                                                                                           |

\* equipped with special dust protection

## Clutch

|                         |                                            |
|-------------------------|--------------------------------------------|
| Design .....            | Single disc, dry, K 10 (Fichtel and Sachs) |
| Pedal free play .....   | 10 to 20 mm (.4'' to .8'')                 |
| Total lining area ..... | 268 sq. cm (41.8 sq. ins.)                 |

## Fuel System

|                                          |                                                          |
|------------------------------------------|----------------------------------------------------------|
| Carburetor .....                         | Downdraught, SOLEX 28 PCI, with accelerator pump         |
| Main jet .....                           | 122.5                                                    |
| Pilot jet .....                          | 50                                                       |
| Pilot jet air bleed .....                | 0.8 mm diam.                                             |
| Air correction jet .....                 | 200                                                      |
| Pump jet .....                           | 50                                                       |
| Pump air correction jet .....            | 2.0                                                      |
| Emulsion tube .....                      | 29                                                       |
| Venturi .....                            | 21.5 mm diam.                                            |
| Float needle valve .....                 | 1.5                                                      |
| Float weight .....                       | 12.5 grams                                               |
| Pump feed .....                          | 0.40—0.55 c. c. per stroke                               |
| Air cleaner .....                        | Oil-bath type                                            |
| Fuel pump .....                          | SOLEX diaphragm type                                     |
| Feeding pressure .....                   | 0.09 to 0.13 atm. (1.28 to 1.85 lbs./sq.in.)             |
| Fuel delivery via float needle valve ... | min. 10 l/h. (approx. 2.5 gals.) at 3000 engine r. p. m. |
| Fuel filter .....                        | Strainer and water excluder at fuel tap                  |

## Electrical System

|                                         |                                                    |
|-----------------------------------------|----------------------------------------------------|
| Electrical system .....                 | 6 V with voltage regulator                         |
| Battery .....                           | 6 V 70 ampere hours                                |
| Generator .....                         | Bosch LJ/REF 160/6—2500 L 4                        |
| Regulator .....                         | Bosch RS/TA 160/6/A 1 on generator                 |
| Ratio, cranksh. — Generator shaft ..... | Approx. 1 : 2                                      |
| Generator commences to charge .....     | At approx. 1800 r. p. m. of the generator          |
| Starter motor .....                     | Bosch EED 0.4/6 L 4                                |
| Lighting System:                        |                                                    |
| Two headlights .....                    | Adjustable, with built-in parking lights           |
| Headlight bulbs .....                   | 35 watts                                           |
| Parking light bulbs .....               | 1.5 watts                                          |
| Two combined stop and tail lights ..... | On rear fenders                                    |
| Stop light bulbs .....                  | 15 watts                                           |
| Tail light bulbs .....                  | 5 watts                                            |
| One license plate light .....           | On engine hood (bonnet)                            |
| License plate light bulb .....          | 5 watts                                            |
| Interior light .....                    | In left-hand roof side member with built-in switch |
| Interior light bulb .....               | 10 watts                                           |
| All control light bulbs .....           | 1.2 watts                                          |
| Speedometer light .....                 | Indirect and adjustable                            |
| Speedometer light bulbs .....           | Two, 1.2 watts                                     |
| Direction indicator lamps .....         | 3 watts                                            |

## Transmission and Final Drive

|                    |                                                                                          |
|--------------------|------------------------------------------------------------------------------------------|
| Transmission ..... | 4 speeds forward, 1 reverse                                                              |
| De Luxe .....      | 2nd, 3rd and 4th gears helically-cut and silent, provided with cone-type synchro-devices |
| Gear ratios .....  | First 3.60 : 1                                                                           |
|                    | Second 1.88 : 1                                                                          |
|                    | Third 1.23 : 1                                                                           |
|                    | Fourth 0.82 : 1                                                                          |
|                    | Reverse 4.63 : 1                                                                         |
| Standard .....     | 3rd and 4th gears helically-cut and silent                                               |
| Gear ratios .....  | First 3.60 : 1                                                                           |
|                    | Second 2.07 : 1                                                                          |
|                    | Third 1.25 : 1                                                                           |
|                    | Fourth 0.80 : 1                                                                          |
|                    | Reverse 6.60 : 1                                                                         |
| Gear control ..... | Manually through linkage, ball-type shift lever on frame tunnel                          |
| Final drive .....  | Helically-cut drive pinion and ring gear, bevel type differential, swinging half axles   |
| Ratio .....        | 4.4 : 1                                                                                  |

## Chassis

|                                              |                                                                                                                        |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Frame .....                                  | Central tubular backbone with large head for mounting the front axle, forked at the rear to accommodate the power unit |
| Wheel suspension: front .....                | Independent, two longitudinal torsion arms on either side                                                              |
| rear .....                                   | Independent, swinging half axles, one longitudinal spring plate on either side                                         |
| Spring: front .....                          | Two square torsion bar springs of 8 steel bands each                                                                   |
| rear .....                                   | One round torsion bar on each side                                                                                     |
| Adjustment of rear torsion bars, unloaded .. | 13° ± 30' inclination of the spring plate                                                                              |
| Shock absorbers: front and rear .....        | Double acting, telescopic                                                                                              |
| Steering .....                               | Worm and sector gear with divided tie rod                                                                              |
| Total ratio .....                            | 14.15                                                                                                                  |
| Turns of steering wheel, lock to lock .....  | 2.4                                                                                                                    |
| Wheel alignment with car fully laden:        |                                                                                                                        |
| Track on ground .....                        | 1290 mm (4 ft. 3 ins.)                                                                                                 |
| Camber .....                                 | 0°40' ± 30'                                                                                                            |
| King pin inclination .....                   | 4°20'                                                                                                                  |
| Caster (front axle tubes) .....              | 2°30' ± 30'                                                                                                            |
| Toe-in (car unladen) .....                   | 1—3 mm (0.04" to 0.12")                                                                                                |
| Wheels .....                                 | Disc wheels with drop-center rims 4 J x 15                                                                             |
| Tires .....                                  | 5.60—15                                                                                                                |
| Tire pressures                               |                                                                                                                        |
| 1—2 Occupants .....                          | Front 1.1 atm. (16 lbs./sq. in.)                                                                                       |
|                                              | Rear 1.4 atm. (20 lbs./sq. in.)                                                                                        |
| Fully occupied .....                         | Front 1.2 atm. (17 lbs./sq. in.)                                                                                       |
|                                              | Rear 1.6 atm. (23 lbs./sq. in.)                                                                                        |
| Brakes                                       |                                                                                                                        |
| De Luxe: foot brake .....                    | Hydraulic (Ate), acting on all wheels                                                                                  |
| hand brake .....                             | Mechanical, acting on rear wheels                                                                                      |
| Standard: foot brake .....                   | Mechanical, acting on all wheels                                                                                       |
| hand brake .....                             | Mechanical, acting on all wheels                                                                                       |
| Braking area: front .....                    | 260 sq. cm (40.3 sq. ins.)                                                                                             |
| rear .....                                   | 260 sq. cm (40.3 sq. ins.)                                                                                             |
| Lubrication system .....                     | Single lubrication points                                                                                              |



## Body

|                               |                                                                                                                                  |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Design .....                  | Two-door, all-steel body with curved sloping front hood and stepless, evenly sloping rear end, bolted to the platform-type frame |
| Fenders and sill panels ..... | Bolted in position, replaceable                                                                                                  |

### Doors:

|                                              |                 |
|----------------------------------------------|-----------------|
| Width .....                                  | 905 mm (37.4'') |
| Angle through which door can be opened ..... | Approx. 70°     |

### Windows:

|                            |                                                              |
|----------------------------|--------------------------------------------------------------|
| Windshield .....           | One-piece, flat                                              |
| Door windows .....         | Vent wings with check-stays, vertically sliding glass panels |
| Rear quarter windows ..... | Fixed in position                                            |
| Rear window .....          | One-piece, curved                                            |
| Glass .....                | Safety type                                                  |
| Windshield wipers .....    | Electric, with 2 wiper arms                                  |

### Seats:

|              |                                             |
|--------------|---------------------------------------------|
| Number ..... | 4—5                                         |
| Front .....  | Adjustable seats with forward-folding backs |
| Rear .....   | Seat bench with forward-folding back        |

### Instrument panel:

|                                   |                                                                                                                                                                    |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Central instrument .....          | Combining speedometer with mileage recorder and speedometer light, built-in warning lights for direction indicators, generator charge, headlights and oil pressure |
| Direction indicator control ..... | Operating lever at steering column below the steering wheel                                                                                                        |
| Ignition switch .....             | Combined ignition and starting switch (ignition key starting)                                                                                                      |
| Glove compartment .....           | Equipped with lid on passenger side                                                                                                                                |

### Interior trim:

|                                  |                                                                                                    |
|----------------------------------|----------------------------------------------------------------------------------------------------|
| Floor .....                      | Covered with rubber mats and trimmed with carpets                                                  |
| Doors and side panels .....      | Trimmed with upholstery cloth                                                                      |
| Roof and roof side members ..... | Lined with cloth                                                                                   |
| Heating .....                    | Warm air heating with two ducts in the front compartment and two defroster vents at the windshield |
| Heating control .....            | Fine adjustment by means of a rotary knob                                                          |
| Luggage compartments .....       | Dust-proof behind the rear seat back and under the theft-proof front bonnet                        |

### Miscellaneous:

|                             |                                                     |
|-----------------------------|-----------------------------------------------------|
| Bumpers .....               | At front and rear, each equipped with two overrides |
| Spare wheel .....           | Theft-proof under front hood                        |
| Fuel tank .....             | Under front hood                                    |
| Tools and accessories ..... | Under front hood                                    |



Speeds at 3400 engine r. p. m.

|                         | De Luxe                     | Standard                       |
|-------------------------|-----------------------------|--------------------------------|
| 1st speed ..... approx. | 25 km. p. h. (16 m. p. h.)  | 25 km. p. h. (16 m. p. h.)     |
| 2nd speed ..... approx. | 47 km. p. h. (29 m. p. h.)  | 43 km. p. h. (27 m. p. h.)     |
| 3rd speed ..... approx. | 73 km. p. h. (45 m. p. h.)  | 72 km. p. h. (45 m. p. h.)     |
| 4th speed ..... approx. | 110 km. p. h. (68 m. p. h.) | 112 km. p. h. (69.6 m. p. h.)  |
| Reverse ..... approx.   | 19 km. p. h. (12 m. p. h.)  | 13.5 km. p. h. ( 8.4 m. p. h.) |

Hill climbing ability (car laden with two persons, on normal roads)

|                              | De Luxe       | Standard      |
|------------------------------|---------------|---------------|
| Hill climbing 1st gear ..... | 37 % (20.5°)  | 37 % (20.5°)  |
| 2nd gear .....               | 18.5% (10.5°) | 20.5% (11.5°) |
| 3rd gear .....               | 11 % ( 6.5°)  | 11 % ( 6.5°)  |
| Top gear .....               | 6 % ( 3.5°)   | 6 % ( 3.5°)   |

## Fuel Consumption

Average fuel consumption on normal roads Metric: 7.5 liters per 100 km. (U. S.: 32 miles per gallon;  
Imp: 38 miles per gallon)

Fuel ..... 74 Octane (Res. F 1)

Oil consumption ..... Between 0.03 and 0.1 liter per 100 km



## Engine

|                                                     |                                                                                                                                                                         |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Design .....                                        | 4-cycle, air-cooled, internal-combustion engine in unit with clutch, transmission and differential in rear of car                                                       |
| Number of cylinders .....                           | 4                                                                                                                                                                       |
| Arrangement of cylinders .....                      | Two pairs horizontally opposed (flat four)                                                                                                                              |
| Bore .....                                          | 77 mm (3.031")                                                                                                                                                          |
| Stroke .....                                        | 64 mm (2.520")                                                                                                                                                          |
| Piston displacement .....                           | 1192 c. c. (72.74 cu. ins.)                                                                                                                                             |
| Compression ratio .....                             | 6.6                                                                                                                                                                     |
| Total weight, dry .....                             | Approx. 90 kg (198 lbs.)                                                                                                                                                |
| Crankcase .....                                     | The magnesium casting alloy crankcase is built in two halves, the joint passing vertically through the centre lines of both the main bearings and the camshaft bearings |
| Cylinders .....                                     | Separately cast and interchangeable, finned for air cooling; made of special grey cast iron                                                                             |
| Cylinders heads .....                               | Cast in pairs, of aluminum alloy, finned for air cooling                                                                                                                |
| Valve seat inserts .....                            | Shrunk in position, made of sintered steel alloy                                                                                                                        |
| Valve guides .....                                  | Shrunk in position, made of bronze                                                                                                                                      |
| Spark plugs inserts .....                           | Screwed in, made of steel                                                                                                                                               |
| Crankshaft .....                                    | High quality steel stamping, four plain bearings                                                                                                                        |
| Main bearings 1, 3, and 4 .....                     | Sleeve-type bearings of aluminum alloy                                                                                                                                  |
| Main bearing 2 (center) .....                       | Sleeve-type half bearing (split) of aluminum alloy                                                                                                                      |
| Flywheel .....                                      | Steel stamping, with integral starter gear ring                                                                                                                         |
| Connecting rods .....                               | H section steel stampings                                                                                                                                               |
| Connecting rod bearings .....                       | Lead-bronze, steel-backed                                                                                                                                               |
| Piston pin bearing .....                            | Pressed-in bronze bushing                                                                                                                                               |
| Pistons .....                                       | Of aluminum alloy with steel-reinforcement                                                                                                                              |
| Piston pins .....                                   | Fully floating, held in position by retaining rings (circlips)                                                                                                          |
| Piston rings .....                                  | 2 compression rings<br>1 oil ring                                                                                                                                       |
| Valve actuating mechanism .....                     | 1 camshaft situated below crankshaft, valves operated via push rods and rocker arms                                                                                     |
| Camshaft .....                                      | Of grey cast iron, runs in three bearings machined direct in crankcase                                                                                                  |
| Camshaft drive .....                                | By helical gears from the crankshaft                                                                                                                                    |
| Valves .....                                        | 1 intake valve and 1 exhaust valve for each cylinder                                                                                                                    |
| Exhaust valve .....                                 | Nickel-chrome plated seating face                                                                                                                                       |
| Arrangement .....                                   | Overhead                                                                                                                                                                |
| Clearance: Intake .....                             | 0.10 mm (0.004")                                                                                                                                                        |
| Exhaust .....                                       | 0.10 mm (0.004")                                                                                                                                                        |
| Valve springs .....                                 | 1 spring per valve                                                                                                                                                      |
| Valve timing with a valve clearance of 1 mm (0.04") |                                                                                                                                                                         |
| Intake opens .....                                  | 2.5° before T. D. C.                                                                                                                                                    |
| Intake closes .....                                 | 37.5° after B. D. C.                                                                                                                                                    |
| Exhaust opens .....                                 | 37.5° before B. D. C.                                                                                                                                                   |
| Exhaust closes .....                                | 2.5° after T. D. C.                                                                                                                                                     |
| Cooling system .....                                | Air cooling by fan on generator armature shaft                                                                                                                          |
| Fan drive .....                                     | From crankshaft through V-belt                                                                                                                                          |
| Cooling air intake .....                            | Thermostat-controlled                                                                                                                                                   |
| Amount of cooling air .....                         | 18 cubic feet per second at 3300 engine r. p. m.                                                                                                                        |
| Lubrication .....                                   | Pressure feed lubrication by gear pump                                                                                                                                  |
| Oil cooling .....                                   | Oil cooler situated in cooling air stream                                                                                                                               |
| Oil pressure control .....                          | By warning light                                                                                                                                                        |
| Ignition .....                                      | Battery ignition                                                                                                                                                        |
| Ignition coil .....                                 | Bosch TE 6 A 3                                                                                                                                                          |
| Ignition distributor .....                          | Bosch VJU 4 BR 8 mk with vacuum advance                                                                                                                                 |
| Spark timing .....                                  | 7.5° before T. D. C.                                                                                                                                                    |
| Firing order .....                                  | 1—4—3—2                                                                                                                                                                 |

|                         |                                                       |
|-------------------------|-------------------------------------------------------|
| Spark advance .....     | By combined centrifugal and vacuum advance mechanisms |
| Breaker point gap ..... | 0.4 mm (.016'')                                       |
| Spark plugs .....       | 14 mm thread, heat range 225                          |
|                         | Bosch W 225 T 1                                       |
|                         | Beru 225/14 u 2                                       |
|                         | Lodge H 14 or HN                                      |
|                         | Champion L 10 S                                       |
|                         | AC F 10                                               |
|                         | KLG F 70                                              |
|                         | Auto-Lite AE 6 or AER 6                               |
| Spark plug gap .....    | 0.6—0.7 mm (.024'' to .028'')                         |

## Clutch

|                         |                                            |
|-------------------------|--------------------------------------------|
| Design .....            | Single disc, dry, K 10 (Fichtel and Sachs) |
| Pedal free play .....   | 10 to 20 mm (0.4'' to 0.8'')               |
| Total lining area ..... | 268 sq. cm (41.8 sq. ins.)                 |

## Fuel System

|                                                |                                                            |
|------------------------------------------------|------------------------------------------------------------|
| Carburetor .....                               | Down draught, SOLEX 28 PCI, with accelerator pump          |
| Main jet .....                                 | 117.5                                                      |
| Pilot jet .....                                | 50                                                         |
| Pilot jet air bleed .....                      | 0.8 mm dia.                                                |
| Air correction jet .....                       | 195                                                        |
| Pump jet .....                                 | 50                                                         |
| Pump air correction jet .....                  | 2.0                                                        |
| Emulsion tube .....                            | 29                                                         |
| Venturi .....                                  | 21.5 mm dia.                                               |
| Float needle valve .....                       | 1.5                                                        |
| Float weight .....                             | 5.7 grams (0.20 oz.), plastic material                     |
| Pump feed .....                                | 0.40—0.60 c. c. per stroke                                 |
| Air cleaner .....                              | Oil-bath type                                              |
| Fuel pump .....                                | SOLEX diaphragm type, mechanically operated                |
| Feeding pressure .....                         | max. 0.13 atm. (1.85 lbs./sq. in.) at 3000 engine r. p. m. |
| Fuel delivery via float needle valve 1.5 ..... | min. 16 l/h. (U. S. 2.5 gals.) at 500—600 engine r. p. m.  |
| Fuel tap .....                                 | Three-way tap with fuel reserve position                   |
| Fuel filter .....                              | Gauze strainer in tank                                     |

## Electrical System

|                                                   |                                                          |
|---------------------------------------------------|----------------------------------------------------------|
| Electrical system .....                           | 6 volts, with voltage regulator                          |
| Battery .....                                     | 6 volts, 66 ampere hours                                 |
| Generator .....                                   | Bosch LJ/REF 160/6/2500 L 17                             |
| Regulator .....                                   | Bosch RS/TAA 160/6/1, mounted on generator               |
| Ratio, cranksh. — Generator shaft .....           | Approx. 1 : 2                                            |
| Generator commences to charge .....               | At approx. 1560 r. p. m. of the generator armature shaft |
| Starter motor .....                               | Bosch EED 0.4/6 L 4                                      |
| Lighting System:                                  |                                                          |
| Two headlamps .....                               | Adjustable, combined with parking lamps                  |
| Rim inner diameter .....                          | 180 mm (7.09'')                                          |
| Headlamp bulbs .....                              | 35/35 watts                                              |
| Parking lamp bulbs .....                          | 2 watts                                                  |
| Two stop/tail lamps with two-filament bulbs ..... | Bezel-type, on rear fenders                              |
| Stop lamp bulbs .....                             | 20 watts                                                 |
| Tail lamp bulbs .....                             | 5 watts                                                  |

|                                         |                                                                    |
|-----------------------------------------|--------------------------------------------------------------------|
| One license plate lamp .....            | In center of engine hood (bonnet), also serving as underhood light |
| One tubular bulb .....                  | 5 watts                                                            |
| One interior light .....                | In left-hand roof side member with built-in switch                 |
| Interior light bulb .....               | 10 watts                                                           |
| Direction indicators .....              | Semaphore-type, mounted in body center pillars                     |
| Tubular bulbs .....                     | 3 watts                                                            |
| All warning light bulbs .....           | 1.2 watts                                                          |
| Instrument light .....                  | Rheostat-controlled                                                |
| Two bulbs .....                         | 1.2 watts                                                          |
| Fuses:                                  |                                                                    |
| For headlamps .....                     | Fuse box (two fuses) under front hood at left-hand wheel arch      |
| For all other electrical equipment .... | Fuse box (four fuses) under front hood on instrument panel         |

## Transmission and Final Drive

|                    |                                                                                                 |
|--------------------|-------------------------------------------------------------------------------------------------|
| Construction ..... | Four speeds, apart from the gears, the transmission case also houses the rear axle differential |
| Transmission ..... | Four speeds forward, 1 reverse                                                                  |
| De Luxe .....      | 2nd, 3rd and 4th gears helically-cut, provided with cone-type synchro-devices                   |
| Gear ratios .....  | First 3.60 : 1<br>Second 1.88 : 1<br>Third 1.23 : 1<br>Fourth 0.82 : 1<br>Reverse 4.63 : 1      |
| Standard .....     | 3rd and 4th gears helically-cut                                                                 |
| Gear ratios .....  | First 3.60 : 1<br>Second 2.07 : 1<br>Third 1.25 : 1<br>Fourth 0.80 : 1<br>Reverse 6.60 : 1      |
| Gear control ..... | Manually through linkage, central ball-type shift lever on frame tunnel                         |
| Final drive .....  | Spiral bevel drive, swinging half axles                                                         |
| Ratio .....        | 4.4 : 1                                                                                         |

## Chassis

|                                              |                                                                                                                                                       |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame .....                                  | Flat platform reinforced by central tubular backbone with large head for mounting the front axle and forked at the rear to accommodate the power unit |
| Wheel suspension: front .....                | Independent, two longitudinal torsion arms on either side                                                                                             |
| rear .....                                   | Independent, swinging half axles, one longitudinal spring plate on either side                                                                        |
| Springs: front .....                         | Two square torsion bar springs of 8 steel bands each, passing through front axle beams                                                                |
| rear .....                                   | One round torsion bar on each side                                                                                                                    |
| Adjustment of rear torsion bars, unloaded .. | 12° ± 30' inclination of the spring plate                                                                                                             |
| Shock absorbers: front and rear .....        | Double acting, telescopic                                                                                                                             |
| Steering .....                               | Worm and sector gear with divided tie rod                                                                                                             |
| Overall ratio .....                          | 14.15                                                                                                                                                 |
| Turns of steering wheel, lock to lock ..     | 2.4                                                                                                                                                   |
| Angle of wheels at full steering lock:       |                                                                                                                                                       |
| inner wheel .....                            | 32°                                                                                                                                                   |
| outer wheel .....                            | 26°                                                                                                                                                   |
| Torque-arm radius .....                      | 16 mm (0.63")                                                                                                                                         |

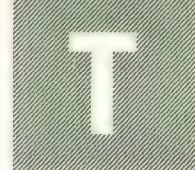


#### Wheel alignment with car fully laden:

|                                            |                                                  |
|--------------------------------------------|--------------------------------------------------|
| Track on ground .....                      | 1290 mm (4 ft. 3 ins.)                           |
| Camber .....                               | 0°40' ± 30'                                      |
| King pin inclination .....                 | 4°20'                                            |
| Caster (front axle tubes) .....            | 2°30' ± 30'                                      |
| Toe-in (car unladen) .....                 | 1—3 mm (0.04'' to 0.12'')                        |
| Wheels .....                               | Steel disc wheels with drop-center rims 4 J x 15 |
| Tires .....                                | 5.60—15                                          |
| Rolling radius .....                       | 307 mm (12.09'')                                 |
| Tire pressures                             |                                                  |
| 1—2 Occupants .....                        | Front 1.1 atm. (16 lbs./sq. in.)                 |
|                                            | Rear 1.4 atm. (20 lbs./sq. in.)                  |
| 3—5 Occupants .....                        | Front 1.2 atm. (17 lbs./sq. in.)                 |
|                                            | Rear 1.6 atm. (23 lbs./sq. in.)                  |
| High speed driving for longer periods .... | Front 1.4 atm. (20 lbs./sq. in.)                 |
|                                            | Rear 1.6 atm. (23 lbs./sq. in.)                  |
| Brakes                                     |                                                  |
| De Luxe: foot brake .....                  | Hydraulic, acting on all wheels                  |
| hand brake .....                           | Mechanical, acting on rear wheels                |
| Standard: foot brake .....                 | Mechanical, acting on all wheels                 |
| hand brake .....                           | Mechanical, acting on all wheels                 |
| Hand brake lever .....                     | Centrally mounted between front seats            |
| Braking area: front .....                  | 260 sq. cm (40.3 sq. ins.)                       |
| rear .....                                 | 260 sq. cm (40.3 sq. ins.)                       |
| Lubrication system .....                   | Single lubrication points                        |

## Body

|                                              |                                                                                                                                                                     |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Design .....                                 | Two-door, all-steel body with dropping front hood and stepless, evenly sloping rear end, bolted to the platform-type frame                                          |
| Fenders and sill panels .....                | Bolted in position, replaceable                                                                                                                                     |
| Doors:                                       |                                                                                                                                                                     |
| Width .....                                  | 905 mm (37.4'')                                                                                                                                                     |
| Angle through which door can be opened ..... | Approx. 70°                                                                                                                                                         |
| Windows:                                     |                                                                                                                                                                     |
| Windshield .....                             | One-piece, flat                                                                                                                                                     |
| Door windows .....                           | Vent wings with check-stays, vertically sliding glass panels                                                                                                        |
| Rear quarter windows .....                   | Fixed in position                                                                                                                                                   |
| Rear window .....                            | One-piece, curved                                                                                                                                                   |
| Glass .....                                  | Heat-treated safety plate, windshield provided with clear vision area                                                                                               |
| Windshield wipers .....                      | Electric, with 2 wiper arms                                                                                                                                         |
| Hoods:                                       |                                                                                                                                                                     |
| Front .....                                  | Rear-hinged, with automatically engaging collapsible prop                                                                                                           |
| Rear .....                                   | Top-hinged, unlocked manually by means of T-handle                                                                                                                  |
| Seats:                                       |                                                                                                                                                                     |
| Number .....                                 | 4—5                                                                                                                                                                 |
| Front .....                                  | Adjustable seats with forward-folding backs                                                                                                                         |
| Rear .....                                   | Seat bench with forward-folding back                                                                                                                                |
| Instrument panel:                            |                                                                                                                                                                     |
| Central instrument .....                     | Combining speedometer with mileage recorder and speedometer light, built-in warning lights for direction indicators, generator charge, headlights, and oil pressure |
| Direction indicator control .....            | Operating lever on steering column below the steering wheel                                                                                                         |
| Ignition switch .....                        | Combined ignition and starting switch (ignition key starting)                                                                                                       |
| Glove compartment .....                      | Equipped with lid on passenger side                                                                                                                                 |



Interior trim:

|                                                               |                               |
|---------------------------------------------------------------|-------------------------------|
| Floor .....                                                   | Covered with rubber mats      |
| Frame tunnel .....                                            | Rubber-covered                |
| Front panel, front side panels, lower body side members ..... | Covered with haircord carpet  |
| Doors and side panels .....                                   | Covered with upholstery cloth |
| Roof .....                                                    | Cloth-lined                   |

Miscellaneous:

|                             |                                                      |
|-----------------------------|------------------------------------------------------|
| Bumpers .....               | At front and rear, each equipped with two overriders |
| Spare wheel .....           | Theft-proof under front hood                         |
| Fuel tank .....             | Under front hood                                     |
| Tools and accessories ..... | Under front hood                                     |

Sliding roof:

|                    |                 |
|--------------------|-----------------|
| Make .....         | Golde           |
| Roof opening:      |                 |
| Clear length ..... | 690 mm (27.2'') |
| Clear width .....  | 730 mm (28.7'') |

## Dimensions and Weights

|                                                          |                           |
|----------------------------------------------------------|---------------------------|
| Wheel base .....                                         | 2400 mm (7 ft. 10.5 ins.) |
| Track: front .....                                       | 1290 mm (4 ft. 3 ins.)    |
| rear .....                                               | 1250 mm (4 ft. 1.2 ins.)  |
| Length .....                                             | 4070 mm (13 ft. 4 ins.)   |
| Width .....                                              | 1540 mm (5 ft. 1/2 in.)   |
| Height (unladen) .....                                   | 1500 mm (4 ft. 11 ins.)   |
| Smallest ground clearance with the car fully laden ..... | 172 mm (6.8 ins.)         |
| Angle of approach .....                                  | 25°                       |
| Angle of departure .....                                 | 16°                       |
| Smallest turning circle .....                            | 11 m (36 ft.)             |

|                                |    | Sedan*) | Convertible<br>4-seater |
|--------------------------------|----|---------|-------------------------|
| Weight, dry .....              | kg | 710     | 780                     |
| Weight, ready for use .....    | kg | 730     | 800                     |
| Maximum load .....             | kg | 380     | 360                     |
| Permissible total weight ..... | kg | 1110    | 1160                    |
| Max. load on front axle .....  | kg | 450     | 480                     |
| Max. load on rear axle .....   | kg | 660     | 680                     |
| Weight of chassis .....        | kg | 435     | 435                     |

\*) Weights apply to Standard, De Luxe, and Sliding Roof Models

## Capacities and Refills

|                                   |                                                                          |
|-----------------------------------|--------------------------------------------------------------------------|
| Fuel tank .....                   | 40 liters, including 5 liters reserve (10.5 U. S. Gals.; 8.8 Imp. Gals.) |
| Crankcase .....                   | 2.5 liters (5.3 U. S. pints; 4.4 Imp. pints)                             |
| Transmission case: Standard ..... | 2.5 liters (5.3 U. S. pints; 4.4 Imp. pints)                             |
| De Luxe .....                     | Refilling quantity: 2 liters (4.2 U. S. pints; 3.5 Imp. pints)           |
|                                   | 2.5 liters (5.3 U. S. pints; 4.4 Imp. pints)                             |
|                                   | Refilling quantity: 2 liters (4.2 U. S. pints; 3.5 Imp. pints)           |
| Steering .....                    | 0.125 liter (0.26 U. S. pint; 0.22 Imp. pint)                            |
| Brake .....                       | 0.25 liter (0.5 U. S. pint; 0.4 Imp. pint)                               |
| Oil bath air cleaner .....        | 0.25 liter (0.5 U. S. pint; 0.4 Imp. pint)                               |

## Performance

|                                                    |                                                              |
|----------------------------------------------------|--------------------------------------------------------------|
| Performance .....                                  | 30 BHP at 3400 r. p. m. (SAE rating: 36 HP at 3700 r. p. m.) |
| Max. torque .....                                  | 7.7 mkg (56 ft. lbs.) at 2000 r. p. m.                       |
| Maximum and cruising speed .....                   | 110 km p. h. (68 m. p. h.)                                   |
| Engine r. p. m. at 110 km p. h. (68 m. p. h.)      |                                                              |
| De Luxe .....                                      | 3400 r. p. m.                                                |
| Standard .....                                     | 3345 r. p. m.                                                |
| Mean piston speed at 110 km p. h.<br>(68 m. p. h.) |                                                              |
| De Luxe .....                                      | approx. 7.25 meters/sec. (23.8 ft.)                          |
| Standard .....                                     | approx. 7.15 meters/sec. (23.5 ft.)                          |

Speeds at 3400 engine r. p. m.

|                 | Standard                              | De Luxe                    |
|-----------------|---------------------------------------|----------------------------|
| 1st speed ..... | approx. 25 km p. h. (16 m. p. h.)     | 25 km p. h. (16 m. p. h.)  |
| 2nd speed ..... | approx. 42 km p. h. (26 m. p. h.)     | 47 km p. h. (29 m. p. h.)  |
| 3rd speed ..... | approx. 72 km p. h. (45 m. p. h.)     | 73 km p. h. (45 m. p. h.)  |
| 4th speed ..... | approx. 112 km p. h. (69.6 m. p. h.)  | 110 km p. h. (68 m. p. h.) |
| Reverse .....   | approx. 13.5 km p. h. ( 8.4 m. p. h.) | 19 km p. h. (12 m. p. h.)  |

Hill climbing ability (car occupied by two persons, on normal roads)

|                              | Standard      | De Luxe       |
|------------------------------|---------------|---------------|
| Hill climbing 1st gear ..... | 37 % (20.5°)  | 37 % (20.5°)  |
| 2nd gear .....               | 20.5% (11.5°) | 18.5% (10.5°) |
| 3rd gear .....               | 11 % ( 6.5°)  | 11 % ( 6.5°)  |
| Fourth gear .....            | 6 % ( 3.5°)   | 6 % ( 3.5°)   |

Acceleration from rest to 80 km p. h.  
(50 m. p. h.) through gears, with car fully  
laden ..... 22 sec.

## Fuel Consumption

|                                          |                                                                                         |
|------------------------------------------|-----------------------------------------------------------------------------------------|
| Average fuel consumption on normal roads | Metric: 7.5 liters per 100 km (U. S.: 32 miles per gallon;<br>Imp: 38 miles per gallon) |
| Fuel .....                               | 74 Octane (Res. F 1)                                                                    |
| Oil consumption .....                    | Between 0.03 and 0.1 liter per 100 km                                                   |





As VW Sedan except for the following:

## Fuel System

|                              |                                                 |
|------------------------------|-------------------------------------------------|
| Carburetor .....             | Downdraught, SOLEX 28 PCI with accelerator pump |
| uVenturi .....               | 21.5 mm dia.                                    |
| uMain jet .....              | 117.5                                           |
| Air correction jet .....     | 180                                             |
| Pilot jet .....              | 50                                              |
| Pilot jet air bleed .....    | 0.8 mm dia.                                     |
| Pmp jet .....                | 50                                              |
| Pmp air correction jet ..... | 2.0                                             |
| Emulsion tube .....          | 29                                              |
| Float needle valve .....     | 1.5                                             |
| Float weight .....           | 5.7 grams (0.20 oz.) plastic material           |
| Pump feed .....              | 0.40—0.60 c. c. per stroke                      |

## Electrical System

|                                           |                                                             |
|-------------------------------------------|-------------------------------------------------------------|
| Lighting:                                 |                                                             |
| Two headlamps .....                       | Adjustable, combined with parking lamps                     |
| Rim inner diameter .....                  | 170 mm (6.7")                                               |
| Headlamp bulbs .....                      | 35/35 watts                                                 |
| Parking lamp bulbs .....                  | 2 watts                                                     |
| Two stop/tail/direction indicator lamps   |                                                             |
| with reflex reflectors .....              | Flush fitting in rear fenders                               |
| Tail light bulbs .....                    | 5 watts                                                     |
| Stop/direction indicator lamp bulbs ..... | 15 watts                                                    |
| One license plate lamp .....              | In center of engine compartment hood                        |
| Two bulbs .....                           | 5 watts                                                     |
| One interior lamp .....                   | Placed centrally above the wingshield, with built-in switch |
| Bulb .....                                | 5 watts                                                     |
| Direction indicators .....                | Bezel type lamps below headlamps                            |
| Bulbs .....                               | 15 watts                                                    |
| At rear .....                             | Combined with stop lamps                                    |

## Chassis

|                                          |                                                                                                    |
|------------------------------------------|----------------------------------------------------------------------------------------------------|
| Front axle .....                         | With stabilizer shaft attached to lower torsion arms                                               |
| Tire pressures:                          |                                                                                                    |
| 1 or 2 occupants .....                   | Front 1.1 kg/cm <sup>2</sup> , rear 1.4 kg/cm <sup>2</sup><br>(16 lbs./sq. in.), (20 lbs./sq. in.) |
| Fully occupied .....                     | Front 1.2 kg/cm <sup>2</sup> , rear 1.6 kg/cm <sup>2</sup><br>(17 lbs./sq. in.), (23 lbs./sq. in.) |
| High speed driving for longer periods .. | Front 1.2 kg/cm <sup>2</sup> , rear 1.6 kg/cm <sup>2</sup><br>(17 lbs./sq. in.), (23 lbs./sq. in.) |

## Dimensions and Weights

|                                           |                       |
|-------------------------------------------|-----------------------|
| Length .....                              | 4,140 mm (163'')      |
| Width .....                               | 1,630 mm (64.2'')     |
| Height (empty) .....                      | 1,325 mm (52.2'')     |
| Angle of approach .....                   | 24°                   |
| Angle of departure .....                  | 16°                   |
| Smallest turning circle .....             | approx. 11 m (36 ft.) |
| Net weight .....                          | 790 kg (1,742 lbs.)   |
| Weight, incl. spare wheel and tools ..... | 810 kg (1,786 lbs.)   |
| Carrying capacity .....                   | 300 kg (661 lbs.)     |
| Max. permissible total weight .....       | 1,110 kg (2,447 lbs.) |
| Max. load on front axle .....             | 450 kg (992 lbs.)     |
| Max. load on rear axle .....              | 660 kg (1,455 lbs.)   |

## Performance

|                                                                      |                                               |
|----------------------------------------------------------------------|-----------------------------------------------|
| Top and cruising speed .....                                         | 115 km. p. h. (72 m. p. h.) at 3,600 r. p. m. |
| Mean piston speed at 115 km. p. h.<br>(72 m. p. h.) .....            | 7.7 meters/sec. (25.3 ft.)                    |
| Hill climbing ability (car occupied by two persons, on normal roads) |                                               |
| 1st gear .....                                                       | 34 % (18.5°)                                  |
| 2nd gear .....                                                       | 17 % (9.5°)                                   |
| 3rd gear .....                                                       | 10.5 % (6°)                                   |
| 4th gear .....                                                       | 5.5 % (3°)                                    |



# List of Tolerances and Wear Limits

# T

The term WEAR LIMIT means that parts which approach, or have already reached, the limit given should not be re-used when carrying out an overhaul. When deciding the wear limit of pistons and cylinders, due consideration should also be given to the oil consumption of the respective engine.

|                                                                                                                         |                 | Tolerance Limits<br>(new parts)       | Wear Limits           |
|-------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------|-----------------------|
| <b>Engine</b>                                                                                                           |                 |                                       |                       |
| 1 - Cylinder seating depth in cylinder head . . . .                                                                     |                 | 13.00—12.90 mm<br>(.512"—.507")       | 14.50 mm<br>(.571")   |
| 2 - Cylinder . . . . . out of round                                                                                     |                 |                                       | 0.01 mm<br>(.0001")   |
| 3 - Piston / cylinder . . . . . clearance                                                                               |                 | 0.035—0.055 mm<br>(.0014"—.0022")     | 0.20 mm<br>(.008")    |
| 4 - Upper and lower compression ring . . . . . side clearance                                                           |                 | 0.035—0.062 mm<br>(.0014"—.0024")     | 0.10 mm<br>(.004")    |
| 5 - Oil scraper ring . . . . . side clearance                                                                           |                 | 0.025—0.052 mm<br>(.001"—.002")       | 0.10 mm<br>(.004")    |
| 6 - All piston rings . . . . . gap                                                                                      |                 | 0.30—0.45 mm<br>(.012"—.018")         | 0.95 mm<br>(.037")    |
| 7 - Weight tolerance of pistons in one engine . .                                                                       |                 | max. 10 g<br>(.35 oz)                 |                       |
| 8 - Weight tolerance of con. rods in one engine                                                                         |                 | max. 11 g<br>(.38 oz)                 |                       |
| 9 - Piston pin / con. rod bush . . . . . clearance                                                                      |                 | 0.005—0.026 mm<br>(.0002"—.001")      | 0.05 mm<br>(.002")    |
| 10 - Connecting rod bearing . . . . . clearance                                                                         |                 | 0.019—0.074 mm<br>(.0007"—.003")      | 0.15 mm<br>(.006")    |
|                                                                                                                         | end play        | 0.170—0.395 mm<br>(.007"—.0155")      | 0.70 mm<br>(.03")     |
| 11 - Crankshaft main bearing (Consideration<br>being paid to the preload of 0.02 mm/0.0008"<br>by the crankcase)        |                 | 0.052—0.115 mm<br>(.002"—.0045")      | 0.19 mm<br>(.007")    |
| a) Bearings 1 to 3 . . . . . clearance                                                                                  |                 | 0.036—0.096 mm<br>(.0014"—.0038")     | 0.17 mm<br>(.006")    |
| b) Bearing 4 . . . . . clearance                                                                                        |                 |                                       |                       |
| 12 - Crankshaft at 2nd and 4th main bearing<br>journals (1st and 3rd bearing journals on<br>V-blocks) . . . . . run-out |                 |                                       | 0.03 mm<br>(.0012")   |
| 13 - Crankshaft / main bearing 1<br>(fitted with 3 different shims) . . . . . end play                                  |                 | 0.070—0.120 mm<br>(.003"—.005")       | 0.15 mm<br>(.006")    |
| 14 - Main bearing journal . . . . . out of round                                                                        |                 |                                       | 0.03 mm<br>(.0012")   |
| 15 - Crank pin . . . . . out of round                                                                                   |                 |                                       | 0.03 mm<br>(.0012")   |
| 16 - Crankcase bore for crankshaft                                                                                      |                 |                                       |                       |
| a) Bearings 1 to 3 . . . . . diameter                                                                                   |                 | 60.000—60.019 mm<br>(2.3622"—2.3630") |                       |
| b) Bearing 4 . . . . . diameter                                                                                         |                 | 50.000—50.025 mm<br>(1.9685"—1.9695") |                       |
| 17 - Fan pulley . . . . . radial run-out                                                                                |                 | max. 1.0 mm<br>(.04")                 |                       |
|                                                                                                                         | lateral run-out | max. 1.0 mm<br>(.04")                 |                       |
| 18 - Crankcase bore for camshaft . . . . . diameter                                                                     |                 | 24.020—24.041 mm<br>(.9457"—.9465")   | 24.070 mm<br>(.9476") |



|                                             |                 |  | Tolerance Limits<br>(new parts)                   | Wear Limits                       |
|---------------------------------------------|-----------------|--|---------------------------------------------------|-----------------------------------|
| 19 - Camshaft                               | clearance       |  | 0.020—0.054 mm<br>(.0008"—.0021")                 | 0.12 mm<br>(.005")                |
|                                             | end play        |  | 0.020—0.074 mm<br>(.0008"—.0029")                 | 0.10 mm<br>(.004")                |
| (between two points)                        | run-out         |  | 0.02 mm<br>(.0008")                               | 0.04 mm<br>(.0016")               |
| 20 - Camshaft timing gear                   | radial run-out  |  | 0.03 mm<br>(.0012")                               |                                   |
|                                             | lateral run-out |  | 0.10 mm<br>(.004")                                |                                   |
|                                             | backlash        |  | 0.010—0.035 mm<br>(.0004"—.0014")                 |                                   |
| 21 - Flywheel                               | lateral run-out |  | max. 0.30 mm<br>(.012")                           |                                   |
|                                             | radial run-out  |  | max. 0.40 mm<br>(.016")                           |                                   |
|                                             | out of balance  |  | max. 5 cmg                                        |                                   |
| Flange                                      | outer diameter  |  | 59.90—60.10 mm $\varnothing$<br>(2.3583"—2.3661") | 59.70 mm<br>(2.3504")             |
| Crankshaft seating depth in flywheel flange |                 |  | 3.22—3.25 mm<br>(.1268"—.1279")                   |                                   |
| Thickness of shoulder in flywheel flange    |                 |  | 6.5—0.2 mm<br>(.2559"—.008")                      | min. 4.8 mm<br>(.1890")           |
| Flange height                               |                 |  | min. 12.5 mm<br>(.4921")                          |                                   |
| Remachining flywheel wall around flange     | diameter        |  |                                                   | 110.0 mm $\varnothing$<br>(.433") |
| Remachining width of teeth                  |                 |  |                                                   | max. 2 mm<br>(.08")               |
| 22 - Valve stem: intake                     | diameter        |  | 6.965—6.955 mm $\varnothing$<br>(.2742"—.2738")   | 6.920 mm<br>(.2724")              |
| exhaust                                     | diameter        |  | 6.955—6.945 mm $\varnothing$<br>(.2738"—.2734")   | 6.920 mm<br>(.2724")              |
|                                             | out of round    |  | 0.01 mm<br>(.004")                                |                                   |
| 23 - Valve guide / valve stem:              |                 |  |                                                   |                                   |
| a) Valve guide                              | inner diameter  |  | 7.000—7.015 mm $\varnothing$<br>(.275"—.2762")    | 7.070 mm<br>(.2783")              |
| b) intake                                   | clearance       |  | 0.035—0.060 mm<br>(.0014"—.0024")                 | 0.15 mm<br>(.006")                |
| exhaust                                     | clearance       |  | 0.045—0.070 mm<br>(.0018"—.0027")                 | 0.15 mm<br>(.006")                |
| 24 - Valve seat:                            |                 |  |                                                   |                                   |
| a) intake                                   | width           |  | 1.3—1.6 mm<br>(.051"—.063")                       |                                   |
| b) exhaust                                  | width           |  | 1.7—2.0 mm<br>(.067"—.079")                       |                                   |
| c) Valve face                               | run-out         |  | 0.01 mm<br>(.0004")                               |                                   |
| 25 - Valve springs                          |                 |  |                                                   |                                   |
| free length 43 mm (1.7")                    |                 |  |                                                   |                                   |
| loaded length 28 mm (1.1")                  | load            |  | 33.4 kg $\pm$ 5%<br>(73.6 lbs.)                   | 30 kg<br>(66 lbs.)                |

|                                                                                                                                                                                                         |                | Tolerance Limits<br>(new parts)                                                                      | Wear Limits                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------|-------------------------------------|
| 26 - Valve clearance (with engine cold) intake and exhaust .....                                                                                                                                        | adjustment     | 0.10 mm<br>(.004")                                                                                   |                                     |
| 27 - a) Rocker arm (after hardening) .....                                                                                                                                                              | inner diameter | 15.99—16.018 mm $\varnothing$<br>(.6295"—.6306")                                                     | 16.035 mm $\varnothing$<br>(.6313") |
| b) Rocker arm shaft .....                                                                                                                                                                               | diameter       | 15.984—15.966 mm $\varnothing$<br>(.6293"—.6285")                                                    | 15.955 mm $\varnothing$<br>(.6281") |
| c) Rocker arm / rocker arm shaft .....                                                                                                                                                                  | clearance      | 0.016—0.052 mm<br>(.0006"—.0020")                                                                    | 0.080 mm<br>(.0031")                |
| 28 - a) Crankcase bore for valve push rod . . .                                                                                                                                                         | diameter       | 15.000—15.018 mm $\varnothing$<br>(.5905"—.5912")                                                    | 15.060 mm $\varnothing$<br>(.5932") |
| b) Valve push rod .....                                                                                                                                                                                 | diameter       | 14.984—14.966 mm $\varnothing$<br>(.5899"—.5892")                                                    | 14.955 mm $\varnothing$<br>(.5888") |
| c) Crankcase bore / valve push rod .....                                                                                                                                                                | clearance      | 0.016—0.052 mm<br>(.0006"—.0020")                                                                    | 0.120 mm<br>(.0047")                |
| 29 - Valve push rod / guide plate .....                                                                                                                                                                 | clearance      | The valve push rod should glide through the guide by its own weight at the lowest possible clearance | 0.02 mm<br>(.0008")                 |
| 30 - Compression .....                                                                                                                                                                                  |                | 6.0—7.5 atm.<br>(85—107 lbs./sq. in.)                                                                | 4.0 atm.<br>57 lbs./sq. in.)        |
| (To be checked with the throttle open and the engine having attained operating temperature, all spark plugs removed, pressure gauge in spark plug seat and the engine turned over by the starter motor) |                |                                                                                                      |                                     |
| 31 - Oil pump: end play of gears with cover removed and gasket in situation .....                                                                                                                       |                | 0.066—0.138 mm<br>(.0026"—.0054")                                                                    | 0.20 mm<br>(.008")                  |
| End play of gears with cover and gasket removed .....                                                                                                                                                   |                |                                                                                                      | 0.10 mm<br>(.004")                  |
| Oil pump gears .....                                                                                                                                                                                    | backlash       | 0.03—0.08 mm<br>(.0012"—.0031")                                                                      |                                     |
| 32 - Oil pressure:                                                                                                                                                                                      |                |                                                                                                      |                                     |
| a) with engine having attained operating temperature (at idling speed) .....                                                                                                                            |                | min. 0.5 atm.<br>(7 lbs./sq. in.)                                                                    |                                     |
| b) with engine having attained operating temperature (at 2500 r. p. m.) .....                                                                                                                           |                | min. 2.5 atm.<br>(35 lbs./sq. in.)                                                                   |                                     |
| 33 - Spring for oil pressure relief valve .....                                                                                                                                                         | free length    | 52—53 mm<br>(2.05"—2.09")                                                                            |                                     |
| 34 - Oil pressure contact opens .....                                                                                                                                                                   | pressure       | 0.3—0.6 atm.<br>(4.3—8.5 lbs./sq. in.)                                                               |                                     |
| 35 - Distance from fan housing to upper edge of throttle ring .....                                                                                                                                     | adjustment     | 20 mm<br>(.8")                                                                                       |                                     |
| 36 - Thermostat: after a water bath of 75 to 80 °C (170 to 180 °F) .....                                                                                                                                | length         | min. 46 mm<br>(1.81")                                                                                |                                     |

|                                                                                                |                                           | Tolerance Limits<br>(new parts)       | Wear Limits             |
|------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------|-------------------------|
| <b>Clutch</b>                                                                                  |                                           |                                       |                         |
| 1 - Clutch driven plate .....                                                                  | lateral run-out                           | max. 0.5 mm<br>(.02")                 |                         |
| 2 - Clutch thrust spring loaded length 29.4 mm<br>(1.16") .....                                | load                                      | 57.5 ± 2.5 kg<br>(127 ± 5.5 lbs.)     | 49 kg<br>(108 lbs.)     |
| 3 - Clutch pedal free play .....                                                               |                                           | 10—20 mm<br>(.4"—.8")                 |                         |
| 4 - Clutch pressure plate .....                                                                | run-out                                   |                                       | 0.10 mm<br>(.004")      |
| 5 - Clutch release plate .....                                                                 | run-out                                   |                                       | 0.30 mm<br>(.012")      |
| 6 - Clutch assy .....                                                                          | out of balance                            | max. 15 cmg                           |                         |
| <b>Front Axle</b>                                                                              |                                           |                                       |                         |
| 1 - Torsion arm .....                                                                          | twist                                     | max. 0.2 mm<br>(.008")                |                         |
| 2 - Torsion arm / fiber bush (the upper limit<br>should be approached, fiber will swell) ..... | clearance                                 | 0.20—0.27 mm<br>(.008"—.010")         | 0.30 mm<br>(.012")      |
| 3 - Torsion arm link pin / sinterised iron bush..                                              | clearance                                 | 0.042—0.087 mm<br>(.0017"—.0034")     | 0.20 mm<br>(.008")      |
| 4 - Torsion arm link pin .....                                                                 | diameter                                  | 17.913—17.940 mm ø<br>(.7052"—.7063") | 17.800 mm ø<br>(.7008") |
| 5 - King pin / bush .....                                                                      | clearance                                 | 0.027—0.034 mm<br>(.0010"—.0013")     | 0.08 mm<br>(.003")      |
| 6 - Front axle tubes .....                                                                     | end play<br>departure from<br>parallelism | (None)<br>max. 0.2 mm<br>(.008")      |                         |
| 7 - Castor (chassis on level surface) .....                                                    |                                           | 2°30' ± 30'                           |                         |
| 8 - Camber (chassis on level surface) .....                                                    |                                           | 0°40' ± 30'                           |                         |
| 9 - Toe-in (car standing on the wheels in unladen<br>condition) .....                          |                                           | 1—3 mm<br>(.04"—.12")                 |                         |
| 10 - King pin inclination .....                                                                |                                           | 4° 20'                                |                         |
| 11 - Steering gear                                                                             |                                           |                                       |                         |
| a) Sector shaft .....                                                                          | end play                                  | 0.25 mm<br>(.0098")                   |                         |
| b) Sector shaft spring .....                                                                   | free length                               | 23.4 ± 0.4 mm<br>(.921"—.016")        |                         |
|                                                                                                | loaded length                             | 20.3 mm<br>(.8")                      |                         |
| Tension of loaded spring .....                                                                 |                                           | 60—75 kg<br>(130—165 lbs.)            |                         |
| c) Sector shaft thrust pin .....                                                               | length                                    | 19.9—20.1 mm<br>(.7835"—.7913")       |                         |



|                                                                                             |                | Tolerance Limits<br>(new parts)                   | Wear Limits                         |
|---------------------------------------------------------------------------------------------|----------------|---------------------------------------------------|-------------------------------------|
| 12 - Steering drop arm / steering gear case . . . .                                         | end play       | 0.4—1.0 mm<br>(.016"—.04")                        |                                     |
| <b>Rear Axle and Transmission</b>                                                           |                |                                                   |                                     |
| 1 - Main drive shaft / pilot bush . . . . .                                                 | clearance      | 0.05—0.15 mm<br>(.002"—.006")                     | 0.25 mm<br>(.0098")                 |
| 2 - Main drive shaft                                                                        |                |                                                   |                                     |
| a) at intermediate ball bearing (between two points) . . . . .                              | run-out        | 0.02 mm<br>(.0008")                               | max. 0.05 mm<br>(.002")             |
| b) at pilot end (with main drive shaft installed) . . . . .                                 | run-out        | 0.10 mm<br>(.004")                                | max. 0.20 mm<br>(.008")             |
| 3 - Preload of gear shift housing . . . . .                                                 |                | 0.02—0.11 mm<br>(.0008"—.0043")                   |                                     |
| 4 - Bushes for transmission shift rod . . . . .                                             | diameter       | 15.025—15.060 mm $\varnothing$<br>(.5915"—.5925") | 15.250 mm $\varnothing$<br>(.6004") |
| 5 - Transmission shift rod . . . . .                                                        | diameter       | 14.957—15.000 mm $\varnothing$<br>(.5888"—.590")  | 14.750 mm $\varnothing$<br>(.5807") |
| 6 - Selector shaft detent spring loaded length<br>21.5 mm (.85") . . . . .                  | load           | 6.2 kg<br>(13.7 lbs.)                             |                                     |
| 7 - Pre-load of transmission case halves on the<br>two differential ball bearings . . . . . |                | 0.10—0.18 mm<br>(.004"—.007")                     |                                     |
| 8 - Rear axle shaft                                                                         |                |                                                   |                                     |
| a) Flat end / fulcrum plates / differential side gear (4 parts) . . . . .                   | clearance      | 0.05—0.023 mm<br>(.002"—.0009")                   | 0.30 mm<br>(.012")                  |
| b) Flat end / differential side gear (measured across the convex sides) . . . . .           | clearance      | 0.03—0.10 mm<br>(.0012"—.004")                    | 0.15 mm<br>(.006")                  |
| 9 - Transmission case / rear axle tube / tube<br>retainer . . . . .                         | clearance      | 0.40—0.60 mm<br>(.016"—.024")                     | 0.70 mm<br>(.027")                  |
| 10 - Rear wheel oil seal . . . . .                                                          | seating depth  | 4.7—5.0 mm<br>(.185"—.197")                       |                                     |
| 11 - Starter shaft bush . . . . .                                                           | inner diameter | 12.545—12.570 mm $\varnothing$<br>(.4939"—.4949") | 12.65 mm $\varnothing$<br>(.4980")  |
| 12 - Starter shaft / bush . . . . .                                                         | clearance      | 0.11—0.16 mm<br>(.0043"—.0063")                   |                                     |
| <b>De Luxe Model Only</b>                                                                   |                |                                                   |                                     |
| 13 - Gear for 2nd speed . . . . .                                                           | end play       | 0.10—0.25 mm<br>(.004"—.0098")                    |                                     |
| 14 - Gear for 3rd speed . . . . .                                                           | end play       | 0.10—0.25 mm<br>(.004"—.0098")                    |                                     |
| 15 - Gear for 4th speed . . . . .                                                           | end play       | 0.10—0.25 mm<br>(.004"—.0098")                    |                                     |

|                                                                                    |                   | Tolerance Limits<br>(new parts)       | Wear Limits         |
|------------------------------------------------------------------------------------|-------------------|---------------------------------------|---------------------|
| 16 - Selector fork / 1st speed gear .....                                          | end play          | 0.5—0.7 mm<br>(.02"—.03")             |                     |
| 17 - Selector shaft / 3rd-and-4th speed operating<br>sleeve .....                  | end play          | 0.2—0.4 mm<br>(.008"—.016")           |                     |
| 18 - Synchronizer stop rings / gears clearance<br>between clutch teeth faces ..... |                   | min. 1.0 mm<br>(.044")                | 0.3 mm<br>(.012")   |
| 19 - Bush for reverse sliding gear .....                                           | inner diameter    | 16.050—16.077 mm<br>(.6319"—.6330")   |                     |
| <b>Standard Model Only</b>                                                         |                   |                                       |                     |
| 20 - Gear for 3rd speed .....                                                      | end play          | 0.20—0.75 mm<br>(.008"—.030")         |                     |
| 21 - Gear for 4th speed .....                                                      | end play          | 0.25—0.40 mm<br>(.0098"—.016")        | 0.50 mm<br>(.02")   |
| 22 - Selector fork / selector ring .....                                           | clearance         | 0.23—0.53 mm<br>(.009"—.021")         |                     |
| 23 - Bush for reverse sliding gear .....                                           | inner diameter    | 16.050—16.093 mm<br>(.6319"—.6336")   |                     |
| <b>Brakes, Wheels</b>                                                              |                   |                                       |                     |
| 1 - Brake master cylinder .....                                                    | diameter          | 19.05 mm<br>(.750")                   |                     |
| Piston push rod measured from ball-shaped<br>end up to nut .....                   | length            | 52—53 mm<br>(2.05"—2.09")             |                     |
| 2 - Brake wheel cylinder: front .....                                              | diameter          | 19.05 mm<br>(.750")                   |                     |
| rear .....                                                                         | diameter          | 17.45 mm<br>(.690")                   |                     |
| 3 - Stop light switch, contacts close at .....                                     | pressure          | 3.5—0.8 atm.<br>(50—114 lbs./sq. in.) |                     |
| 4 - Brake drum .....                                                               | lateral run-out   | max. 0.25 mm<br>(.0098")              | 0.35 mm<br>(.0138") |
|                                                                                    | radial run-out    | max. 0.25 mm<br>(.0098")              | 0.25 mm<br>(.0098") |
|                                                                                    | thickness of wall | 4.90—5.25 mm<br>(.193"—.206")         | 4.0 mm<br>(.16")    |
|                                                                                    | inner diameter    | 230.0±0.2 mm<br>(9.05"—.008")         | 231.5 mm<br>(9.11") |
|                                                                                    | taper             | max. 0.1 mm<br>(.004")                |                     |
| 5 - Brake lining .....                                                             | thickness         | 3.8—4.0 mm<br>(.15"—.16")             | 2.7 mm<br>(.106")   |
| Oversize .....                                                                     | thickness         | 4.3—4.5 mm<br>(.17"—.18")             | 3.2 mm<br>(.126")   |
| 6 - Wheel .....                                                                    | radial run-out    | max. 1.5 mm<br>(.06")                 |                     |
|                                                                                    | lateral run-out   | max. 1.5 mm<br>(.06")                 |                     |
| 7 - Rear wheels — toe-out .....                                                    |                   | 0—4 mm<br>(0"—.16")                   |                     |
| (Car laden, spring plates horizontal)                                              |                   |                                       |                     |
| 8 - Spring plates, unloaded .....                                                  | adjustment        | 13°±30'                               |                     |



# List of Tolerances and Wear Limits

(From January 1954)

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The term WEAR LIMIT means that parts which approach, or have already reached, the limit given should not be re-used when carrying out an overhaul. When deciding the wear limit of pistons and cylinders, due consideration should also be given to the oil consumption of the respective engine.

|                                                                                                                  |                 | Tolerance Limits<br>(new parts)       | Wear Limits           |
|------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------|-----------------------|
| <b>Engine (1192 cc)</b>                                                                                          |                 |                                       |                       |
| 1 - Cylinder seating depth in cylinder head ....                                                                 |                 | 12.90—13.00 mm<br>(.507"—.512")       | 14.50 mm<br>(.571")   |
| 2 - Cylinder .....                                                                                               | out of round    |                                       | 0.01 mm<br>(.0001")   |
| 3 - Piston/cylinder .....                                                                                        | clearance       | 0.036—0.054 mm<br>(.0014"—.0021")     | 0.20 mm<br>(.008")    |
| 4 - Upper and lower compression rin .....                                                                        | side clearance  | 0.035—0.062 mm<br>(.0014"—.0024")     | 0.10 mm<br>(.004")    |
| 5 - Oil scraper ring .....                                                                                       | side clearance  | 0.025—0.052 mm<br>(.001"—.002")       | 0.10 mm<br>(.004")    |
| 6 - All piston rings .....                                                                                       | gap             | 0.30—0.45 mm<br>(.012"—.018")         | 0.95 mm<br>(.037")    |
| 7 - Weight tolerance of pistons in one engine ..                                                                 |                 | max. 10 g<br>(.35 oz)                 |                       |
| 8 - Weight tolerance of con. rods in one engine                                                                  |                 | max. 11 g<br>(.38 oz)                 |                       |
| 9 - Piston pin/con. rod bush .....                                                                               | clearance       | 0.005—0.026 mm<br>(.0002"—.001")      | 0.05 mm<br>(.002")    |
| 10 - Connecting rod bearing .....                                                                                | clearance       | 0.019—0.074 mm<br>(.0007"—.003")      | 0.15 mm<br>(.006")    |
|                                                                                                                  | end play        | 0.170—0.395 mm<br>(.007"—.0155")      | 0.70 mm<br>(.03")     |
| 11 - Crankshaft main bearing (Consideration<br>being paid to the preload of 0.025 mm/0.001"<br>by the crankcase) |                 |                                       |                       |
| a) Bearings 1 to 3 .....                                                                                         | clearance       | 0.047—0.110 mm<br>(.0019"—.004")      | 0.19 mm<br>(.007")    |
| b) Bearing 4 .....                                                                                               | clearance       | 0.031—0.091 mm<br>(.0012"—.0036")     | 0.17 mm<br>(.006")    |
| 12 - Crankshaft at 2nd and 4th main bearing<br>journals (1st and 3rd bearing journals on<br>V-blocks) .....      | run-out         |                                       | 0.03 mm<br>(.0012")   |
| 13 - Crankshaft/main bearing 1<br>(fitted with different shims) .....                                            | end play        | 0.070—0.120 mm<br>(.003"—.005")       | 0.15 mm<br>(.006")    |
| 14 - Main bearing journal .....                                                                                  | out of round    |                                       | 0.03 mm<br>(.0012")   |
| 15 - Crank pin .....                                                                                             | out of round    |                                       | 0.03 mm<br>(.0012")   |
| 16 - Crankcase bore for crankshaft                                                                               |                 |                                       |                       |
| a) Bearings 1 to 3 .....                                                                                         | diameter        | 60.000—60.019 mm<br>(2.3622"—2.3630") |                       |
| b) Bearing 4 .....                                                                                               | diameter        | 50.000—50.025 mm<br>(1.9685"—1.9695") |                       |
| 17 - Fan pulley .....                                                                                            | radial run-out  | max. 0.8 mm<br>(.031")                |                       |
|                                                                                                                  | lateral run-out | max. 0.3 mm<br>(.012")                |                       |
| 18 - Crankcase bore for camshaft .....                                                                           | diameter        | 24.020—24.041 mm<br>(.9457"—.9465")   | 24.070 mm<br>(.9476") |



|                                             |                 |  | Tolerance Limits<br>(new parts)     | Wear Limits             |
|---------------------------------------------|-----------------|--|-------------------------------------|-------------------------|
| 19 - Camshaft                               | clearance       |  | 0.020—0.054 mm<br>(.0008"—.0021")   | 0.12 mm<br>(.005")      |
|                                             | end play        |  | 0.020—0.074 mm<br>(.0008"—.0029")   | 0.10 mm<br>(.004")      |
| (between two points)                        | run-out         |  | 0.02 mm<br>(.0008")                 | 0.04 mm<br>(.0016")     |
| 20 - Camshaft timing gear                   | radial run-out  |  | 0.03 mm<br>(.0012")                 |                         |
|                                             | lateral run-out |  | 0.10 mm<br>(.004")                  |                         |
|                                             | backlash        |  | 0.010—0.035 mm<br>(.0004"—.0014")   |                         |
| 21 - Flywheel                               | lateral run-out |  | max. 0.30 mm<br>(.012")             |                         |
|                                             | radial run-out  |  | max. 0.40 mm<br>(.016")             |                         |
|                                             | out of balance  |  | max. 5 cmg                          |                         |
| Flange                                      | outer diameter  |  | 60.10—59.90 mm<br>(2.3661"—2.3583") | 59.70 mm<br>(2.3504")   |
| Crankshaft seating depth in flywheel flange |                 |  | 3.22—3.25 mm<br>(.1268"—.1279")     |                         |
| Thickness of shoulder in flywheel flange    |                 |  | 6.5—6.2 mm<br>(.2165"—.2088")       | min. 4.8 mm<br>(.1890") |
| Flange height                               |                 |  | min. 12.5 mm<br>(.4921")            |                         |
| Remachining flywheel wall around flange     | diameter        |  |                                     | 110.0 mm<br>(4.33")     |
| Remachining width of teeth                  |                 |  |                                     | max. 2 mm<br>(.08")     |
| 22 - Valve stem: intake                     | diameter        |  | 6.965—6.955 mm<br>(.2742"—.2738")   | 6.920 mm<br>(.2724")    |
| exhaust                                     | diameter        |  | 6.955—6.945 mm<br>(.2738"—.2734")   | 6.920 mm<br>(.2724")    |
|                                             | out of round    |  | 0.01 mm<br>(.004")                  |                         |
| 23 - Valve guides: intake                   | inner diam.     |  | 7.008—7.023 mm<br>(.2759"—.2765")   | 7.070 mm<br>(.2783")    |
| exhaust                                     | inner diam.     |  | 7.023—7.038 mm<br>(.2765"—.2767")   | 7.080 mm<br>(.2787")    |
| 24 - Valve guide/valve stem: intake         | clearance       |  | 0.043—0.068 mm<br>(.0017"—.0027")   | 0.15 mm<br>(.006")      |
| exhaust                                     | clearance       |  | 0.068—0.093 mm<br>(.0027"—.0037")   | 0.16 mm<br>(.0063")     |
| 25 - Valve seat:                            |                 |  |                                     |                         |
| a) intake                                   | width           |  | 1.3—1.6 mm<br>(.051"—.063")         |                         |
| b) exhaust                                  | width           |  | 1.7—2.0 mm<br>(.067"—.079")         |                         |
| c) valve face                               | run-out         |  | 0.01 mm<br>(.0004")                 |                         |
| 26 - Valve springs                          |                 |  |                                     |                         |
| free length 43 mm (1.7")                    |                 |  |                                     |                         |
| loaded length 28 mm (1.1")                  | load            |  | 33.4 ± 5%<br>(73.6 lbs.)            | 30 kg<br>(66 lbs.)      |



# List of Tolerances and Wear Limits

(From April 1956)

T

## General

The term Wear Limit means that parts which approach, or have already reached, the limit given should not be re-used when carrying out an overhaul. When deciding the wear limit of pistons and cylinders, due consideration should also be given to the oil consumption of the respective engine.

|                                                                                                                 |                | Tolerance Limits<br>(new parts)                     | Wear Limits         |
|-----------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------|---------------------|
| <b>Engine (1192 ccm — 30 HP)</b>                                                                                |                |                                                     |                     |
| 1 - Cylinder seating depth in cylinder head . . . .                                                             |                | 12.90—13.00 mm<br>(.507"—.512")                     | 14.50 mm<br>(.571") |
| 2 - Cylinder . . . . .                                                                                          | out of round   |                                                     | 0.01 mm<br>(.0001") |
| 3 - Piston/cylinder . . . . .                                                                                   | clearance      | 0.036—0.055 mm<br>(.0014"—.0022")                   | 0.20 mm<br>(.008")  |
| 4 - Upper and lower compression ring . . . . .                                                                  | side clearance | 0.045—0.072 mm<br>(.0018"—.0028")                   | 0.10 mm<br>(.004")  |
| 5 - Oil scraper ring . . . . .                                                                                  | side clearance | 0.025—0.052 mm<br>(.001"—.002")                     | 0.10 mm<br>(.004")  |
| 6 - Both compression rings . . . . .                                                                            | gap            | 0.30—0.45 mm<br>(.012"—.018")                       | 0.95 mm<br>(.037")  |
| Oil scraper ring . . . . .                                                                                      | gap            | 0.25—0.40 mm<br>(.0098"—.016")                      | 0.95 mm<br>(.037")  |
| 7 - Weight tolerance of pistons in one engine . .                                                               |                | max. 5 grams<br>(.18 oz)                            |                     |
| 8 - Weight tolerance of con. rods in one engine                                                                 |                | max. 5 grams<br>(.18 oz)                            |                     |
| 9 - Piston pin/con. rod bush . . . . .                                                                          | clearance      | 0.005—0.026 mm<br>(.0002"—.001")                    | 0.05 mm<br>(.002")  |
| 10 - Connection rod bearing . . . . .                                                                           | clearance      | 0.019—0.074 mm<br>(.0007"—.003")                    | 0.15 mm<br>(.006")  |
|                                                                                                                 | end play       | 0.170—0.395 mm<br>(.007"—.0155")                    | 0.70 mm<br>(.03")   |
| 11 - Crankshaft main bearing (consideration<br>being paid to the preload of 0.025 mm/.001"<br>by the crankcase) |                |                                                     |                     |
| a - Bearings 1 to 3 . . . . .                                                                                   | clearance      | 0.047—0.102 mm<br>(.0019"—.05")                     | 0.19 mm<br>(.007")  |
| b - Bearing 4 . . . . .                                                                                         | clearance      | 0.031—0.083 mm<br>(.0012"—.0033")                   | 0.17 mm<br>(.006")  |
| 12 - Crankshaft at 2nd and 4th main bearing<br>journals (1st and 3rd bearing journals on<br>V-blocks) . . . . . | run-out        |                                                     | 0.03 mm<br>(.0012") |
| 13 - Crankshaft/main bearing 1<br>(fitted with different shims) . . . . .                                       | end play       | 0.070—0.120 mm<br>(.003"—.005")                     | 0.15 mm<br>(.006")  |
| 14 - Crankshaft . . . . .                                                                                       | out of balance | max. 8 cmg                                          |                     |
| 15 - Main bearing journal . . . . .                                                                             | out of round   |                                                     | 0.03 mm<br>(.0012") |
| 16 - Crank pin . . . . .                                                                                        | out of round   |                                                     | 0.03 mm<br>(.0012") |
| 17 - Crankcase bore for crankshaft                                                                              |                |                                                     |                     |
| a - Bearings 1 to 3 . . . . .                                                                                   | diameter       | 60.000—60.019 mm $\varnothing$<br>(2.3622"—2.3630") |                     |
| b - Bearing 4 . . . . .                                                                                         | diameter       | 50.000—50.025 mm $\varnothing$<br>(1.9685"—1.9695") |                     |

|                                                                        |                                  | Tolerance Limits<br>(new parts)                   | Wear Limits                         |
|------------------------------------------------------------------------|----------------------------------|---------------------------------------------------|-------------------------------------|
| 18 - Fan pulley                                                        | radial run-out                   | max. 0.8 mm<br>(.031")                            |                                     |
|                                                                        | lateral run-out                  | max. 0.3 mm<br>(.012")                            |                                     |
| 19 - Crankcase bore for camshaft                                       | diameter                         | 24.020—24.041 mm $\varnothing$<br>(.9457"—.9465") | 24.070 mm $\varnothing$<br>(.9476") |
| 20 - Camshaft                                                          | clearance                        | 0.020—0.054 mm<br>(.0008"—.0021")                 | 0.12 mm<br>(.005")                  |
| Guide bearing                                                          | end play                         | 0.020—0.074 mm<br>(.0008"—.0029")                 | 0.10 mm<br>(.004")                  |
| (between two points)                                                   | run-out                          | 0.02 mm<br>(.0008")                               | 0.04 mm<br>(.0016")                 |
| 21 - Camshaft timing gear                                              | radial run-out                   | 0.03 mm<br>(.0012")                               |                                     |
|                                                                        | lateral run-out                  | 0.10 mm<br>(.004")                                |                                     |
|                                                                        | backlash                         | 0.010—0.035 mm<br>(.0004"—0.014")                 |                                     |
| 22 - Flywheel                                                          | lateral run-out                  | max. 0.30 mm<br>(.012")                           |                                     |
| (at gear ring)                                                         | radial run-out                   | max. 0.40 mm<br>(.016")                           |                                     |
|                                                                        | unbalance                        | max. 5 cmg                                        |                                     |
| Flange                                                                 | outer diameter                   | 59.90—60.10 mm $\varnothing$<br>(2.3583"—2.3661") | 59.70 mm $\varnothing$<br>(2.3504") |
|                                                                        | height                           | min. 12.5 mm<br>(.4921")                          |                                     |
|                                                                        | crankshaft<br>seating depth      | 3.25—3.33 mm<br>(.1279"—.0131")                   |                                     |
|                                                                        | thickness of<br>collar in flange | 6.3—6.7 mm<br>(.25"—.26")                         | min. 4.8 mm<br>(.1890")             |
| Providing flywheel face with recess of<br>110 mm (4.33") around flange | wall thickness                   |                                                   | min. 4.4 mm<br>(.1732")             |
| Removing metal from gear ring                                          |                                  |                                                   | max. 2.0 mm<br>(.08")               |
| 23 - Valve stem: intake                                                | diameter                         | 6.965—6.955 mm $\varnothing$<br>(.2742"—.2738")   | 6.920 mm $\varnothing$<br>(.2724")  |
| exhaust                                                                | diameter                         | 6.955—6.945 mm $\varnothing$<br>(.2738"—.2734")   | 6.920 mm $\varnothing$<br>(.2724")  |
|                                                                        | out of round                     | 0.01mm<br>(.004")                                 |                                     |
| 24 - Valve guides: intake                                              | inside diameter                  | 7.008—7.023 mm $\varnothing$<br>(.2759"—.2765")   | 7.070 mm $\varnothing$<br>(.2783")  |
| exhaust                                                                | inside diameter                  | 7.023—7.038 mm $\varnothing$<br>(.2765"—.2767")   | 7.080 mm $\varnothing$<br>(.2787")  |
| 25 - Valve guide/valve stem: intake                                    | clearance                        | 0.043—0.068 mm<br>(.0017"—.0027")                 | 0.15 mm<br>(.006")                  |
| exhaust                                                                | clearance                        | 0.068—0.093 mm<br>(.0027"—.0037")                 | 0.16 mm<br>(.0063")                 |
| 26 - Valve seat: intake                                                | width                            | 1.3—1.6 mm<br>(.051"—.063")                       |                                     |
| exhaust                                                                | width                            | 1.7—2.0 mm<br>(.067"—.079")                       |                                     |
| valve seating face                                                     | run-out                          | 0.01 mm<br>(.0004")                               |                                     |



|                                                                                                                                                                                                                                                          |  | Tolerance Limits<br>(new parts)                                                                                  | Wear Limits                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| 27 - Valve springs: free length 43 mm (1.7")<br>loaded length 28 mm (1.1") .. load                                                                                                                                                                       |  | 33.4 kg $\pm$ 5%<br>(73.6 lbs.)                                                                                  | 30 kg<br>(66 lbs.)                  |
| 28 - Valve clearance (with engine cold)<br>intake and exhaust ..... adjustment                                                                                                                                                                           |  | 0.10 mm<br>(.004")                                                                                               |                                     |
| 29 - a - Rocker arm ..... inside diameter                                                                                                                                                                                                                |  | 15.990–16.018 mm $\varnothing$<br>(.6295"–.6306")                                                                | 16.035 mm $\varnothing$<br>(.6313") |
| b - Rocker arm shaft ..... diameter                                                                                                                                                                                                                      |  | 15.984–15.966 mm $\varnothing$<br>(.6293"–.6285")                                                                | 15.955 mm $\varnothing$<br>(.6281") |
| c - Rocker arm/rocker arm shaft ..... clearance                                                                                                                                                                                                          |  | 0.006–0.052 mm<br>(.0002"–.0020")                                                                                | 0.080 mm<br>(.0031")                |
| 30 - a - Crankcase bore for valve push rod ..... diameter                                                                                                                                                                                                |  | 15.000–15.018 mm $\varnothing$<br>(.5905"–.5912")                                                                | 15.060 mm $\varnothing$<br>(.5932") |
| b - Valve push rod ..... diameter                                                                                                                                                                                                                        |  | 14.984–14.966 mm $\varnothing$<br>(.5899"–.5892")                                                                | 14.955 mm $\varnothing$<br>(.5888") |
| c - Crankcase bore/valve push rod ..... clearance                                                                                                                                                                                                        |  | 0.016–0.052 mm<br>(.0006"–.0020")                                                                                | 0.120 mm<br>(.0047")                |
| 31 - Valve push rod/guide plate ..... clearance                                                                                                                                                                                                          |  | The valve push rod<br>should glide through<br>the guide by its own<br>weight at the lowest<br>possible clearance | 0.02 mm<br>(.0008")                 |
| 32 - Compression<br>(To be checked with the throttle open and<br>the engine having attained operating tem-<br>perature, all spark plugs removed, pressure<br>gauge in spark plug seat and the engine<br>turned over by the starter motor) ..... pressure |  | 7.0–8.5 atm.<br>(100–121 lbs./sq. in.)                                                                           | 4.5 atm.<br>(64 lbs./sq.in.)        |
| 33 - Oil pump:<br>end play of gears with cover removed and<br>gasket in situation ..... end play                                                                                                                                                         |  | 0.066–0.183 mm<br>(.0026"–.0072")                                                                                | 0.20 mm<br>(.008")                  |
| end play of gears with cover and gasket<br>removed ..... end play                                                                                                                                                                                        |  |                                                                                                                  | 0.10 mm<br>(.004")                  |
| Oil pump gears ..... backlash                                                                                                                                                                                                                            |  | 0.03–0.08 mm<br>(.0012"–.0031")                                                                                  |                                     |
| 34 - Oil pressure (only for SAE 20 oil):<br>a - with engine having attained operating<br>temperature (at idling speed) .....                                                                                                                             |  | min. 0.5 atm.<br>(7 lbs./sq. in.)                                                                                |                                     |
| b - at oil temperature of 70° C (158° F) and<br>2500 engine r. p. m. ....                                                                                                                                                                                |  | min. 2.0 atm.<br>(28 lbs./sq. in.)                                                                               |                                     |
| 35 - Spring for oil pressure relief valve ..... free length                                                                                                                                                                                              |  | 52–53 mm<br>(2.05"–2.09")                                                                                        |                                     |
| 36 - Oil pressure contact opens ..... pressure                                                                                                                                                                                                           |  | 0.3–0.6 atm.<br>(4.3–8.5 lbs./sq. in.)                                                                           |                                     |
| 37 - Distance from fan housing to upper edge of<br>throttle ring ..... adjustment                                                                                                                                                                        |  | 20 mm<br>(.8")                                                                                                   |                                     |
| 38 - Thermostat: after a water bath of 75 to<br>80° C (170 to 180° F) ..... length                                                                                                                                                                       |  | min. 46 mm<br>(1.81")                                                                                            |                                     |

|                                                                                                                          |                                | Tolerance Limits<br>(new parts)                   | Wear Limits                         |
|--------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------------------|-------------------------------------|
| <b>Clutch</b>                                                                                                            |                                |                                                   |                                     |
| 1 - Clutch driven plate .....                                                                                            | lateral run-out                | max. 0.5 mm<br>(.02")                             |                                     |
| 2 - Clutch thrust spring:<br>Passenger Cars:<br>length, unloaded 51.7 mm (2.04")<br>loaded 29.4 mm (1.16")<br>Load ..... |                                | 55—60 kg<br>(121—132 lbs.)                        | 49 kg<br>(108 lbs.)                 |
| 3 - Clutch pedal free play .....                                                                                         |                                | 10—20 mm<br>(.4"—.8")                             |                                     |
| 4 - Clutch pressure plate .....                                                                                          | run-out                        |                                                   | 0.10 mm<br>(.004")                  |
| 5 - Clutch release plate .....                                                                                           | run-out                        |                                                   | 0.30 mm<br>(.012")                  |
| 6 - Clutch assy .....                                                                                                    | unbalance                      | max. 15 cmg                                       |                                     |
| <b>Front Axle</b>                                                                                                        |                                |                                                   |                                     |
| 1 - Torsion arm .....                                                                                                    | twist                          | max. 0.2 mm<br>(.008")                            |                                     |
| 2 - Torsion arm/fiber bush (upper limit should<br>be approached, fiber is apt to swell) .....                            | clearance                      | 0.20—0.27 mm<br>(.008"—.010")                     | 0.35 mm<br>(.014")                  |
| 3 - Torsion arm link pin/sintered iron bush ...                                                                          | clearance                      | 0.042—0.087 mm<br>(.0017"—.0034")                 | 0.20 mm<br>(.008")                  |
| 4 - Torsion arm link pin .....                                                                                           | diameter                       | 17.940—17.913 mm $\varnothing$<br>(.7063"—.7052") | 17.800 mm $\varnothing$<br>(.7008") |
| 5 - King pin/bush .....                                                                                                  | clearance                      | 0.027—0.034 mm<br>(.0010"—.0013")                 | 0.08 mm<br>(.003")                  |
|                                                                                                                          | end play                       | (None)                                            |                                     |
| 6 - Alignment of front axle tubes, departure<br>from parallelism .....                                                   |                                | max. 0.2 mm<br>(.008")                            |                                     |
| 7 - Front wheel alignment (chassis on level<br>surface)                                                                  |                                |                                                   |                                     |
| a - with permissible total weight:                                                                                       |                                |                                                   |                                     |
| Camber .....                                                                                                             |                                | 0° 40' $\pm$ 30'                                  |                                     |
| King pin inclination .....                                                                                               |                                | 4° 20'                                            |                                     |
| Caster (Axle tubes) .....                                                                                                |                                | 2° 30' $\pm$ 15'                                  |                                     |
| b - with car in unladen condition:                                                                                       |                                |                                                   |                                     |
| Toe-in (at rim flange) .....                                                                                             |                                | 1—3 mm<br>(.04"—.12")                             |                                     |
| 8 - Steering gear                                                                                                        |                                |                                                   |                                     |
| a - Sector shaft .....                                                                                                   | end play                       | 0.25 mm<br>(.0098")                               |                                     |
| b - Sector shaft spring .....                                                                                            | free length                    | 23.4 $\pm$ 0.4 mm<br>(.921"—.016")                |                                     |
|                                                                                                                          | loaded length                  | 20.3 mm<br>(.8")                                  |                                     |
|                                                                                                                          | Tension of loaded spring ..... | 60—75 kg<br>(130—165 lbs.)                        |                                     |
| c - Sector shaft thrust pin .....                                                                                        | length                         | 19.9—20.1 mm<br>(.7835"—.7913")                   |                                     |
| 9 - Steering drop arm/steering gear case .....                                                                           | end play                       | 0.4—1.0 mm<br>(.016"—.04")                        |                                     |

|                                                                                        |                 | Tolerance Limits<br>(new parts)                   | Wear Limits                         |
|----------------------------------------------------------------------------------------|-----------------|---------------------------------------------------|-------------------------------------|
| <b>Rear Axle and Transmission</b>                                                      |                 |                                                   |                                     |
| 1 - Main drive shaft/pilot bush .....                                                  | clearance       | 0.09—0.147 mm<br>(.004"—.006")                    | 0.25 mm<br>(.0098")                 |
| 2 - Main drive shaft                                                                   |                 |                                                   |                                     |
| a - at intermediate ball bearing<br>(between two points) .....                         | run-out         | 0.02 mm<br>(.0008")                               | max. 0.05 mm<br>(.002")             |
| b - at pilot end (with main drive shaft<br>installed) .....                            | run-out         |                                                   | max. 0.20 mm<br>(.002")             |
| 3 - Preload of gear shift housing .....                                                |                 | 0.02—0.11 mm<br>(.0008"—.0043")                   |                                     |
| 4 - Bushes for transmission shift rod .....                                            | inside diameter | min. 15.015 $\varnothing$<br>(.5911")             | 15.250 mm $\varnothing$<br>(.6004") |
| 5 - Transmission shift rod .....                                                       | diameter        | 15.000—14.957 mm $\varnothing$<br>(.590"—.5888")  | 14.570 mm $\varnothing$<br>(.5807") |
| 6 - Selector shaft detent spring, loaded length<br>21.5 mm (.85") .....                | load            | 6.2 kg<br>(13.7 lbs.)                             |                                     |
| 7 - Preload of transmission case halves on the<br>two differential ball bearings ..... |                 | 0.10—0.18 mm<br>(.004"—.007")                     |                                     |
| 8 - Rear axle shaft                                                                    |                 |                                                   |                                     |
| a - Flat end/fulcrum plates differential side<br>gear (4 parts) .....                  | clearance       | 0.05—0.23 mm<br>(.002"—.009")                     | 0.30 mm<br>(.012")                  |
| b - Flat end/differential side gear (measured<br>across the convex sides) .....        | clearance       | 0.03—0.10 mm<br>(.0012"—.004")                    | 0.15 mm<br>(.006")                  |
| 9 - Transmission case/rear axle tube/tube re-<br>tainer .....                          | clearance       | 0.40—0.60 mm<br>(.016"—.024")                     | 0.70 mm<br>(.027")                  |
| 10 - Rear wheel oil seal .....                                                         | seating depth   | 4.7—5.0 mm<br>(.185"—.197")                       |                                     |
| 11 - Starter shaft bush .....                                                          | inside diameter | 12.545—12.570 mm $\varnothing$<br>(.4939"—.4949") | 12.65 mm $\varnothing$<br>(.4980")  |
| 12 - Starter shaft/bush .....                                                          | clearance       | 0.105—0.16 mm<br>(.0043"—.0063")                  |                                     |
| <b>De Luxe Model Only</b>                                                              |                 |                                                   |                                     |
| 13 - Gear for 2nd speed .....                                                          | end play        | 0.10—0.25 mm<br>(.004"—.0098")                    |                                     |
|                                                                                        | clearance       | 0.04—0.072 mm<br>(.0016"—.0028")                  |                                     |
| 14 - Gear for 3rd speed .....                                                          | end play        | 0.10—0.25 mm<br>(.004"—.0098")                    |                                     |
|                                                                                        | clearance       | 0.04—0.068 mm<br>(.0016"—.0027")                  |                                     |
| 15 - Gear for 4th speed .....                                                          | end play        | 0.10—0.25 mm<br>(.004"—.0098")                    |                                     |
|                                                                                        | clearance       | 0.04—0.074 mm<br>(.0016"—.0029")                  |                                     |
| 16 - Selector fork/1st speed gear .....                                                | end play        | 0.5—0.7 mm<br>(.02"—.03")                         |                                     |
| 17 - Selector shaft/3rd and 4th speed operating<br>sleeve .....                        | end play        | 0.2—0.4 mm<br>(.008"—.016")                       |                                     |



|                                                                                                |                   | Tolerance Limits<br>(new parts)                       | Wear Limits                       |
|------------------------------------------------------------------------------------------------|-------------------|-------------------------------------------------------|-----------------------------------|
| 18 - Selector fork/reverse sliding gear .....                                                  | end play          | 0.2—0.5 mm<br>(.008"—.02")                            |                                   |
| 19 - Synchronizer stop rings/gears clearance<br>between clutch teeth faces .....               |                   | min. 0.8 mm<br>(.03")                                 | 0.30 mm<br>(.012")                |
| 20 - Bush for reverse sliding gear .....                                                       | inside diameter   | 16.050—16.077 mm $\varnothing$<br>(.6319"—.6330")     |                                   |
| <b>Standard Model Only</b>                                                                     |                   |                                                       |                                   |
| 21 - Gear for 3rd speed .....                                                                  | end play          | 0.20—0.75 mm<br>(.008"—.030")                         |                                   |
| 22 - Gear for 4th speed .....                                                                  | end play          | 0.25—0.40 mm<br>(.0098"—.016")                        | 0.50 mm<br>(.02")                 |
| 23 - Selector fork/selector ring .....                                                         | end play          | 0.23—0.53 mm<br>(.0091"—.0208")                       |                                   |
| 24 - Bush for reverse sliding gear .....                                                       | inside diameter   | 16.050—16.093 mm $\varnothing$<br>(.6319"—.6336")     |                                   |
| <b>Brakes and Wheels</b>                                                                       |                   |                                                       |                                   |
| 1 - Brake master cylinder .....                                                                | diameter          | 19.05 mm $\varnothing$<br>(.750")                     |                                   |
| Piston push rod measured from ball-shaped<br>end up to nut .....                               | length            | 52—53 mm<br>(2.05"—2.09")                             |                                   |
| 2 - Brake wheel cylinder, front .....                                                          | diameter          | 19.05 mm $\varnothing$<br>(.750")                     |                                   |
| rear .....                                                                                     | diameter          | 17.45 mm $\varnothing$<br>(.690")                     |                                   |
| 3 - Stop light switch, contacts close at .....                                                 | pressure          | 3.5—8.0 atm.<br>(50—114 lbs./sq. in.)                 |                                   |
| 4 - Brake drum .....                                                                           | lateral run-out   | max. 0.25 mm<br>(.0098")                              | 0.35 mm<br>(.0138")               |
|                                                                                                | radial run-out    | max. 0.25 mm<br>(.0098")                              | 0.25 mm<br>(.0098")               |
|                                                                                                | thickness of wall | 5.25—4.90 mm<br>(.206"—.193")                         | 4.0 mm<br>(.16")                  |
|                                                                                                | inside diameter   | 230.0+0.2 mm $\varnothing$<br>(9.05"+.008")           | 231.5 mm $\varnothing$<br>(9.11") |
|                                                                                                | taper             | max. 0.1 mm<br>(.004")                                |                                   |
| 5 - Brake lining .....                                                                         | thickness         | 4.0—3.8 mm<br>(.16"—.15")                             | 2.7 mm<br>(.106")                 |
| Oversize .....                                                                                 | thickness         | 4.5—4.3 mm<br>(.18"—.17")                             | 3.2 mm<br>(.126")                 |
|                                                                                                | width             | 30 mm<br>(1.18")                                      |                                   |
| 6 - Wheel .....                                                                                | radial run-out    | max. 1.5 mm<br>(.06")                                 |                                   |
|                                                                                                | lateral run-out   | max. 1.5 mm<br>(.06")                                 |                                   |
| 7 - Rear Wheels (spring plate adjustment accord-<br>ing to instructions and car unladen) ..... |                   | toe-in 1 mm<br>(.04")<br>to toe-out 2.5 mm<br>(.098") |                                   |
| 8 - Spring plates, unloaded .....                                                              | adjustment        | 12° $\pm$ 30'                                         |                                   |



## Conversion Factors

### Metric to English

#### LENGTH

|                             |             |         |
|-----------------------------|-------------|---------|
| Millimeters to Inches ..... | multiply by | 0.03937 |
| Centimeters to Inches ..... |             | 0.3937  |
| Meters to Feet .....        |             | 3.2808  |
| Meters to Yards .....       |             | 1.0936  |
| Kilometers to Miles .....   |             | 0.6214  |

#### WEIGHT

|                             |             |         |
|-----------------------------|-------------|---------|
| Grammes to Ounces .....     | multiply by | 0.03527 |
| Kilogrammes to lbs. ....    |             | 2.2046  |
| Tons (Metric) to tons ..... |             | 0.9842  |

#### LIQUID

|                                  |             |        |
|----------------------------------|-------------|--------|
| Liters to U. S. gallons .....    | multiply by | 0.2642 |
| Liters to Imperial gallons ..... |             | 0.2200 |
| Liters to U. S. pints .....      |             | 2.114  |
| Liters to Imperial pints .....   |             | 1.7598 |

#### PRESSURE

|                                                   |             |        |
|---------------------------------------------------|-------------|--------|
| Kg/cm <sup>2</sup> to lbs./in. <sup>2</sup> ..... | multiply by | 14.223 |
|---------------------------------------------------|-------------|--------|

#### TEMPERATURE

|                                  |                            |  |
|----------------------------------|----------------------------|--|
| °Centigrade to °Fahrenheit ..... | multiply by 9/5 and add 32 |  |
|----------------------------------|----------------------------|--|

### English to Metric

#### LENGTH

|                             |             |         |
|-----------------------------|-------------|---------|
| Inches to millimeters ..... | multiply by | 25.4001 |
| Inches to centimeters ..... |             | 2.54    |
| Feet to meters .....        |             | 0.3048  |
| Yards to meters .....       |             | 0.9144  |
| Miles to kilometers .....   |             | 1.609   |

#### WEIGHT

|                             |             |        |
|-----------------------------|-------------|--------|
| Ounces to grammes .....     | multiply by | 28.35  |
| Lbs. to kilogrammes .....   |             | 0.4536 |
| Tons to tons (Metric) ..... |             | 1.016  |

#### LIQUID

|                                  |             |       |
|----------------------------------|-------------|-------|
| U. S. gallons to liters .....    | multiply by | 3.785 |
| Imperial gallons to liters ..... |             | 4.546 |
| U. S. Pints to liters .....      |             | 0.473 |
| Imperial pints to liters .....   |             | 0.568 |

#### PRESSURE

|                                                   |             |         |
|---------------------------------------------------|-------------|---------|
| Lbs./in. <sup>2</sup> to kg/cm <sup>2</sup> ..... | multiply by | 0.07031 |
|---------------------------------------------------|-------------|---------|

#### TEMPERATURE

|                                  |                              |  |
|----------------------------------|------------------------------|--|
| °Fahrenheit to °Centigrade ..... | subtract 32 and multiply 5/9 |  |
|----------------------------------|------------------------------|--|

# 

1 Millimeter (mm) = 0.039370 Inch (")

| Millim.          | Inches | Millim.          | Inches | Millim.       | Inches | Millim.        | Inches | Millim.           | Inches |
|------------------|--------|------------------|--------|---------------|--------|----------------|--------|-------------------|--------|
| 1/100 : .000394  |        | 51/100 : .020079 |        | 1 : .039370   |        | 51 : 2.007870  |        | 105 : 4.133848    |        |
| 2 : .000787      |        | 52 : .020472     |        | 2 : .078740   |        | 52 : 2.047240  |        | 110 : 4.330700    |        |
| 3 : .001181      |        | 53 : .020866     |        | 3 : .118110   |        | 53 : 2.086610  |        | 115 : 4.527550    |        |
| 4 : .001575      |        | 54 : .021260     |        | 4 : .157480   |        | 54 : 2.125980  |        | 120 : 4.724400    |        |
| 5 : .001969      |        | 55 : .021654     |        | 5 : .196850   |        | 55 : 2.165350  |        | 125 : 4.921250    |        |
| 6 : .002362      |        | 56 : .022047     |        | 6 : .236220   |        | 56 : 2.204720  |        | 130 : 5.118100    |        |
| 7 : .002756      |        | 57 : .022441     |        | 7 : .275590   |        | 57 : 2.244090  |        | 135 : 5.314950    |        |
| 8 : .003150      |        | 58 : .022835     |        | 8 : .314960   |        | 58 : 2.283460  |        | 140 : 5.511800    |        |
| 9 : .003543      |        | 59 : .023228     |        | 9 : .354330   |        | 59 : 2.322830  |        | 145 : 5.708650    |        |
| 10 : .003937     |        | 60 : .023622     |        | 10 : .393700  |        | 60 : 2.362200  |        | 150 : 5.905500    |        |
| 11/100 : .004331 |        | 61/100 : .024016 |        | 11 : .433070  |        | 61 : 2.401570  |        | 155 : 6.102350    |        |
| 12 : .004724     |        | 62 : .024409     |        | 12 : .472440  |        | 62 : 2.440940  |        | 160 : 6.299200    |        |
| 13 : .005118     |        | 63 : .024803     |        | 13 : .511810  |        | 63 : 2.480310  |        | 165 : 6.496050    |        |
| 14 : .005512     |        | 64 : .025197     |        | 14 : .551180  |        | 64 : 2.519680  |        | 170 : 6.692900    |        |
| 15 : .005906     |        | 65 : .025591     |        | 15 : .590550  |        | 65 : 2.559050  |        | 175 : 6.889750    |        |
| 16 : .006299     |        | 66 : .025984     |        | 16 : .629920  |        | 66 : 2.598420  |        | 180 : 7.086600    |        |
| 17 : .006693     |        | 67 : .026378     |        | 17 : .669290  |        | 67 : 2.637790  |        | 185 : 7.283450    |        |
| 18 : .007087     |        | 68 : .026772     |        | 18 : .708660  |        | 68 : 2.677160  |        | 190 : 7.480300    |        |
| 19 : .007480     |        | 69 : .027165     |        | 19 : .748030  |        | 69 : 2.716530  |        | 195 : 7.677150    |        |
| 20 : .007874     |        | 70 : .027559     |        | 20 : .787400  |        | 70 : 2.755900  |        | 200 : 7.874000    |        |
| 21/100 : .008268 |        | 71/100 : .027953 |        | 21 : .826770  |        | 71 : 2.795270  |        | 210 : 8.267700    |        |
| 22 : .008661     |        | 72 : .028346     |        | 22 : .866140  |        | 72 : 2.834640  |        | 220 : 8.661400    |        |
| 23 : .009055     |        | 73 : .028740     |        | 23 : .905510  |        | 73 : 2.874010  |        | 230 : 9.055100    |        |
| 24 : .009449     |        | 74 : .029134     |        | 24 : .944880  |        | 74 : 2.913380  |        | 240 : 9.448800    |        |
| 25 : .009843     |        | 75 : .029528     |        | 25 : .984250  |        | 75 : 2.952750  |        | 250 : 9.842500    |        |
| 26 : .010236     |        | 76 : .029921     |        | 26 : 1.023620 |        | 76 : 2.992120  |        | 260 : 10.236200   |        |
| 27 : .010630     |        | 77 : .030315     |        | 27 : 1.062990 |        | 77 : 3.031490  |        | 270 : 10.629900   |        |
| 28 : .011024     |        | 78 : .030709     |        | 28 : 1.102360 |        | 78 : 3.070860  |        | 280 : 11.023600   |        |
| 29 : .011417     |        | 79 : .031102     |        | 29 : 1.141730 |        | 79 : 3.110230  |        | 290 : 11.417300   |        |
| 30 : .011811     |        | 80 : .031496     |        | 30 : 1.181100 |        | 80 : 3.149600  |        | 300 : 11.811000   |        |
| 31/100 : .012205 |        | 81/100 : .031890 |        | 31 : 1.220470 |        | 81 : 3.188970  |        | 310 : 12.204700   |        |
| 32 : .012598     |        | 82 : .032283     |        | 32 : 1.259840 |        | 82 : 3.228340  |        | 320 : 12.598400   |        |
| 33 : .012992     |        | 83 : .032677     |        | 33 : 1.299210 |        | 83 : 3.267710  |        | 330 : 12.992100   |        |
| 34 : .013386     |        | 84 : .033071     |        | 34 : 1.338580 |        | 84 : 3.307080  |        | 340 : 13.385800   |        |
| 35 : .013780     |        | 85 : .033465     |        | 35 : 1.377949 |        | 85 : 3.346450  |        | 350 : 13.779500   |        |
| 36 : .014173     |        | 86 : .033858     |        | 36 : 1.417319 |        | 86 : 3.385820  |        | 360 : 14.173200   |        |
| 37 : .014567     |        | 87 : .034252     |        | 37 : 1.456689 |        | 87 : 3.425190  |        | 370 : 14.566900   |        |
| 38 : .014961     |        | 88 : .034646     |        | 38 : 1.496050 |        | 88 : 3.464560  |        | 380 : 14.960600   |        |
| 39 : .015354     |        | 89 : .035039     |        | 39 : 1.535430 |        | 89 : 3.503930  |        | 390 : 15.354300   |        |
| 40 : .015748     |        | 90 : .035433     |        | 40 : 1.574800 |        | 90 : 3.543300  |        | 400 : 15.748000   |        |
| 41/100 : .016142 |        | 91/100 : .035827 |        | 41 : 1.614170 |        | 91 : 3.582670  |        | 500 : 19.685000   |        |
| 42 : .016535     |        | 92 : .036220     |        | 42 : 1.653540 |        | 92 : 3.622040  |        | 600 : 23.622000   |        |
| 43 : .016929     |        | 93 : .036614     |        | 43 : 1.692910 |        | 93 : 3.661410  |        | 700 : 27.559000   |        |
| 44 : .017323     |        | 94 : .037008     |        | 44 : 1.732280 |        | 94 : 3.700780  |        | 800 : 31.496000   |        |
| 45 : .017717     |        | 95 : .037402     |        | 45 : 1.771650 |        | 95 : 3.740150  |        | 900 : 35.433000   |        |
| 46 : .018110     |        | 96 : .037795     |        | 46 : 1.811020 |        | 96 : 3.779520  |        | 1000 : 39.370000  |        |
| 47 : .018504     |        | 97 : .038189     |        | 47 : 1.850390 |        | 97 : 3.818890  |        | 2000 : 78.740000  |        |
| 48 : .018898     |        | 98 : .038583     |        | 48 : 1.889760 |        | 98 : 3.858260  |        | 3000 : 118.110000 |        |
| 49 : .019291     |        | 99 : .038976     |        | 49 : 1.929130 |        | 99 : 3.897630  |        | 4000 : 157.480000 |        |
| 50 : .019685     |        | 1 mm : .039370   |        | 50 : 1.968500 |        | 100 : 3.937000 |        | 5000 : 196.850000 |        |



# Inches to Millimeters

1 Inch (") = 25.4000508 millimeters (mm)

| Inches            | Millimeters | Inches      | Millimeters | Inches    | Millimeters |            |
|-------------------|-------------|-------------|-------------|-----------|-------------|------------|
| $\frac{1}{64}$ :  | .015 625 :  | 0,396 875 8 | .0001 :     | 0,002 540 | .40 :       | 10,160 020 |
| $\frac{1}{32}$ :  | .031 250 :  | 0,793 752   | .0002 :     | 0,005 080 | .41 :       | 10,414 020 |
| $\frac{3}{64}$ :  | .046 875 :  | 1,190 627   | .0003 :     | 0,007 620 | .42 :       | 10,668 021 |
| $\frac{1}{16}$ :  | .062 500 :  | 1,587 503   | .0004 :     | 0,010 160 | .43 :       | 10,922 021 |
| $\frac{5}{64}$ :  | .078 125 :  | 1,984 379   | .0005 :     | 0,012 700 | .44 :       | 11,176 022 |
| $\frac{3}{32}$ :  | .093 750 :  | 2,381 255   | .0006 :     | 0,015 240 | .45 :       | 11,430 022 |
| $\frac{7}{64}$ :  | .109 375 :  | 2,778 131   | .0007 :     | 0,017 780 | .46 :       | 11,684 023 |
| $\frac{1}{8}$ :   | .125 000 :  | 3,175 006   | .0008 :     | 0,020 320 | .47 :       | 11,938 023 |
| $\frac{9}{64}$ :  | .140 625 :  | 3,571 882   | .0009 :     | 0,022 860 | .48 :       | 12,192 024 |
| $\frac{5}{32}$ :  | .156 250 :  | 3,968 958   |             |           | .49 :       | 12,446 024 |
| $\frac{11}{64}$ : | .171 875 :  | 4,365 634   | .001 :      | 0,025 400 | .50 :       | 12,700 025 |
| $\frac{3}{16}$ :  | .187 500 :  | 4,762 510   | .002 :      | 0,050 800 | .51 :       | 12,954 025 |
| $\frac{13}{64}$ : | .203 125 :  | 5,159 385   | .003 :      | 0,076 200 | .52 :       | 13,208 026 |
| $\frac{7}{32}$ :  | .218 750 :  | 5,556 261   | .004 :      | 0,101 600 | .53 :       | 13,462 026 |
| $\frac{15}{64}$ : | .234 375 :  | 5,953 137   | .005 :      | 0,127 000 | .54 :       | 13,716 027 |
| $\frac{1}{4}$ :   | .250 000 :  | 6,350 013   | .006 :      | 0,152 400 | .55 :       | 13,970 027 |
| $\frac{17}{64}$ : | .265 625 :  | 6,746 889   | .007 :      | 0,177 800 | .56 :       | 14,224 028 |
| $\frac{9}{32}$ :  | .281 250 :  | 7,143 764   | .008 :      | 0,203 200 | .57 :       | 14,478 028 |
| $\frac{19}{64}$ : | .296 875 :  | 7,540 640   | .009 :      | 0,228 600 | .58 :       | 14,732 029 |
| $\frac{5}{16}$ :  | .312 500 :  | 7,937 516   |             |           | .59 :       | 14,986 029 |
| $\frac{21}{64}$ : | .328 125 :  | 8,334 392   | .01 :       | 0,254 000 | .60 :       | 15,240 030 |
| $\frac{11}{32}$ : | .343 750 :  | 8,731 268   | .02 :       | 0,508 001 | .61 :       | 15,494 030 |
| $\frac{23}{64}$ : | .359 375 :  | 9,128 143   | .03 :       | 0,762 001 | .62 :       | 15,748 031 |
| $\frac{3}{8}$ :   | .375 000 :  | 9,525 019   | .04 :       | 1,016 002 | .63 :       | 16,002 032 |
| $\frac{25}{64}$ : | .390 625 :  | 9,921 895   | .05 :       | 1,270 002 | .64 :       | 16,256 032 |
| $\frac{13}{32}$ : | .406 250 :  | 10,318 771  | .06 :       | 1,524 003 | .65 :       | 16,510 033 |
| $\frac{27}{64}$ : | .421 875 :  | 10,715 647  | .07 :       | 1,778 003 | .66 :       | 16,764 033 |
| $\frac{7}{16}$ :  | .437 500 :  | 11,112 522  | .08 :       | 2,032 004 | .67 :       | 17,018 034 |
| $\frac{29}{64}$ : | .453 125 :  | 11,509 398  | .09 :       | 2,286 004 | .68 :       | 17,272 034 |
| $\frac{15}{32}$ : | .468 750 :  | 11,906 274  |             |           | .69 :       | 17,526 035 |
| $\frac{31}{64}$ : | .484 375 :  | 12,303 150  | .10 :       | 2,540 005 | .70 :       | 17,780 035 |
| $\frac{1}{2}$ :   | .500 000 :  | 12,700 026  | .11 :       | 2,794 005 | .71 :       | 18,034 036 |
| $\frac{33}{64}$ : | .515 625 :  | 13,096 901  | .12 :       | 3,048 006 | .72 :       | 18,288 036 |
| $\frac{17}{32}$ : | .531 250 :  | 13,493 777  | .13 :       | 3,302 006 | .73 :       | 18,542 037 |
| $\frac{35}{64}$ : | .546 875 :  | 13,890 653  | .14 :       | 3,556 007 | .74 :       | 18,796 037 |
| $\frac{9}{16}$ :  | .562 500 :  | 14,287 529  | .15 :       | 3,810 007 | .75 :       | 19,050 038 |
| $\frac{37}{64}$ : | .578 125 :  | 14,684 405  | .16 :       | 4,064 008 | .76 :       | 19,304 038 |
| $\frac{19}{32}$ : | .593 750 :  | 15,081 280  | .17 :       | 4,318 008 | .77 :       | 19,558 039 |
| $\frac{39}{64}$ : | .609 375 :  | 15,478 156  | .18 :       | 4,572 009 | .78 :       | 19,812 039 |
| $\frac{5}{8}$ :   | .625 000 :  | 15,875 032  | .19 :       | 4,826 009 | .79 :       | 20,066 040 |
| $\frac{41}{64}$ : | .640 625 :  | 16,271 908  |             |           | .80 :       | 20,320 040 |
| $\frac{21}{32}$ : | .656 250 :  | 16,668 784  | .20 :       | 5,080 010 | .81 :       | 20,574 041 |
| $\frac{43}{64}$ : | .671 875 :  | 17,065 659  | .21 :       | 5,334 010 | .82 :       | 20,828 041 |
| $\frac{11}{16}$ : | .687 500 :  | 17,462 535  | .22 :       | 5,588 011 | .83 :       | 21,082 042 |
| $\frac{45}{64}$ : | .703 125 :  | 17,859 411  | .23 :       | 5,842 012 |             |            |
| $\frac{23}{32}$ : | .718 750 :  | 18,256 287  | .24 :       | 6,096 012 |             |            |
| $\frac{47}{64}$ : | .734 375 :  | 18,653 163  |             |           |             |            |
| $\frac{3}{4}$ :   | .750 000 :  | 19,050 038  |             |           |             |            |

| Inches                    | Millimeters  | Inches | Millimeters | Inches | Millimeters |
|---------------------------|--------------|--------|-------------|--------|-------------|
| $\frac{49}{64}$ : .765675 | : 19,446914  | .25    | : 6,350012  | .84    | : 21,336042 |
| $\frac{25}{32}$ : .781250 | : 19,843790  | .26    | : 6,604013  | .85    | : 21,590043 |
| $\frac{51}{64}$ : .796875 | : 20,240666  | .27    | : 6,858013  | .86    | : 21,844043 |
| $\frac{13}{16}$ : .812500 | : 20,637541  | .28    | : 7,112014  | .87    | : 22,098044 |
| $\frac{53}{64}$ : .828125 | : 21,034417  | .29    | : 7,366014  | .88    | : 22,352044 |
| $\frac{27}{32}$ : .843750 | : 21,431293  |        |             | .89    | : 22,606045 |
| $\frac{55}{64}$ : .859375 | : 21,828169  | .30    | : 7,620015  | .90    | : 22,860045 |
| $\frac{7}{8}$ : .875000   | : 22,225045  | .31    | : 7,874015  | .91    | : 23,114046 |
| $\frac{57}{64}$ : .890625 | : 22,621921  | .32    | : 8,128016  | .92    | : 23,368046 |
| $\frac{29}{32}$ : .906250 | : 23,018796  | .33    | : 8,382016  | .93    | : 23,622047 |
| $\frac{59}{64}$ : .921875 | : 23,415672  | .34    | : 8,636017  | .94    | : 23,876047 |
| $\frac{15}{16}$ : .937500 | : 23,812548  | .35    | : 8,890017  | .95    | : 24,130048 |
| $\frac{61}{64}$ : .953125 | : 24,209424  | .36    | : 9,144018  | .96    | : 24,384048 |
| $\frac{31}{32}$ : .968750 | : 24,606300  | .37    | : 9,398018  | .97    | : 24,638049 |
| $\frac{63}{64}$ : .984375 | : 25,003175  | .38    | : 9,652019  | .98    | : 24,892049 |
| 1 : 1.000000              | : 25,4000508 | .39    | : 9,906019  | .99    | : 25,146050 |



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